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BULLETIN 625 JULY 1961

# Factors in

# Rural Neighborhood Development

## In Alcorn County, Mississippi

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# Summary of Findings and Implications

Fifteen of the 37 neighborhoods in Alcorn County, Mississippi, were studied ntensively for suggestions as to factors conducive to neighborhood development organization. The problem was to discover in what kind of neighborhoods, clubs were likely to succeed, and to delineate those factors which facilitate or hinder the organization and growth of Community Development Clubs.

The 15 sample neighborhoods were lassified in terms of degree of development organization as (1) the five which had Community Development Clubs, (2) he four which had other development organizations but not Community Clubs, and (3) the six which had no development organizations. The other development organizations were three women's Home Demonstration Clubs, one civic lub, and eight 4-H Clubs. The Community Club neighborhoods varied from he other two neighborhood groups in 1) economic and population characterstics, (2) extent of activity within the neighborhood, and (3) the number and kind of outside contacts.

Certain combinations of economic and population characteristics seemed to facilitate neighborhood organization, while others appeared to hinder it. In the Community Club neighborhoods families had adopted more improved agricultural practices, had more work income with ewer not gainfully employed, more ousehold heads in the productive ages with higher education, and a larger proportion of households with a relatively igh level of living. The organized neighborhoods on the average were larger than he unorganized and had lost less populaon. A minimum of around 20 families nterested in organizational activity seemd necessary for the successful operaon of a Community Development Club. Neighborhood organization seemed to deend not so much on number of families s on number of families of a relatively igh socio-economic level. There was no correlation between number of households nd the proportion of neighborhood families represented in the club.

The major characteristic found to be associated with the organization and growth of Community Development Clubs was a long history of interaction or activity at the neighborhood level. As compared with other neighborhood groups, Community Club neighborhoods had more services to promote neighborhood contacts and a longer history of organizational activity. There had been more schools, churches, economic services, and organizations. This strong local activity resulted in strong neighborhood identity. More Community Club neighborhoods had columns in the county paper, their names had been recognized over a longer period, and their boundaries had remained more stable than in the other neighborhoods.

In the Community Club neighborhoods there was not only more activity within neighborhood boundaries, but there were also more contacts with the outside. Families had more frequent contacts with the development agencies at the county seat, and, in turn, received more assistance from county seat leaders. When neighborhoods were weak, it was observed that their geographic location might be unfavorable for organization if they were either too far from the county seat or too near it. Community Club neighborhood residents had more memberships in outside secular organizations, and the kinds of organizations participated in were more likely to promote development than those participated in by families in the other two neighborhood groups.

The study indicated that it was in the neighborhoods already relatively strong that the Communty Development Clubs were more likely to succeed, rather than in the weaker neighborhoods where development organization might seem to offer a last hope for neighborhood survival. Implications seem to portend that neighborhoods strengthened by development organizations may continue to persist as significant social units but that the declining, inactive neighborhoods will likely soon disappear.

# FACTORS IN RURAL NEIGHBORHOOD DEVELOPMENT IN ALCORN COUNTY, MISSISSIPPI

By LUCY W. COLE and HAROLD F. KAUFMAN*

## Introduction

In the transition from an agricultural society with small farm operators living and working on dispersed farmsteads to an industrialized society with population massed around an urban center and rural residents commuting to this center for work in trades and services, the rural neighborhood faces a crucial period of adjustment. In Mississippi as elsewhere small rural areas are being rapidly drained of population, and the larger trade centers on the whole have increased in size during recent decades.[1] Rural development organizations are to be seen as major agencies in adjustment. The chief organization concerned with overall development activities and adjustments to these occupational shifts and population changes is found in some areas to be the rural neighborhood development club, known locally as the Community Development Club.[2] The Community Development Club is an inclusive family-type organization with a multi-interest program for achieving "Better Homes on Better Farms in Better Communities." In Alcorn County, Mississippi, the area of this study, Community Development Clubs were organized in 11 of the neighborhoods and in five of the 15 sample neighborhoods of this study.

**Problem and Objective**

Because of the important role of Community Clubs in rural development, the feasibility of attempting to organize them in other neighborhoods deserves careful consideration. The objective of this study is to delineate factors which facilitate or hinder the organization and growth of development agencies. As mentioned above, the most significant development agency found in Alcorn County was the Community Developmnt Club. This study deals only with factors external to this club which are congenial or detrimental to its organization.[3] An active Community Development Club is hypothesized to be related to three clusters of factors, namely: (1) economic and population characteristics, (2) interaction within neighborhood boundaries, and (3) con-

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*The authors are Research Assistant and Sociologist, respectively, in the Department of Sociology and Rural Life, Mississippi Agricultural Experiment Station. Special credit is due Wilfrid C. Bailey, who together with one of the authors, first saw the need for this study and supplied suggestions and data. See Wilfrid C. Bailey and Harold F. Kaufman, **Factors Related to Differential Participation Among Neighborhoods** (State College: Miss. Agr. Experiment Station Division of Sociology and Rural Life, Preliminary Reports in Community Organization, No. 3, Oct., 1956.) Credit is also due Frank D. Alexander and Andrew W. Baird, who supplied data.

The Tennessee Valley Authority cooperated with the work in Alcorn County. Members of the staff of the Agricultural Economics Branch, Division of Agricultural Relations, gave valuable assistance throughout. The TVA share in the research was officially known as the "Mississippi Community Fertilizer Education Experiment."

[1] For the last decade see **Preliminary Reports, Population Counts for States,** 1960 Census of Population, PC (P1)-26, Aug. 1960 (U. S. Dept. of Commerce, Bureau of the Census), pp. 1-2.

[2] The term, community, is used by the local residents to refer to a neighborhood. A neighborhood in this study refers to a small spatial cluster of families possessing some group consciousness and having one or more common services. Its essence is seen in the frequency and nature of interaction drawing residents together for the accomplishment of desired ends. Other neighborhood characteristics are implicit throughout the report. See Andrew W. Baird and Wilfrid C. Bailey, **Community Development Clubs in Alcorn County Mississippi** (State College: Miss. State Univ. Agr. Exp. Sta. Bul. 597, May, 1960.)

[3] Dynamics within this club have been analyzed by Baird and Bailey, **op. cit.**

tacts outside the neighborhood. The first cluster is the situation or setting within which the interaction takes place, and the others deal with the interaction itself.

The clubs in Alcorn County have been organized under direction of the County Agricultural Extension Agents, who have secured the cooperation of other agricultural agencies and civic-minded organizations with an interest in rural improvement. The Alcorn County Development Council—composed of representatives of all rural Community Development Clubs, the sponsoring civic organizations, and professional agricultural workers in the county—serves as a coordinating agency.

Other neighborhood organizations carrying out development activities in the sample neighborhoods at the time of this study were the women's Home Demonstration Clubs, a men's civic club, and the 4-H Clubs for boys and girls. These clubs, like the Community Development Club, carried out multi-interest programs, but not nearly so broad, of general neighborhood improvement and also assisted in making adjustments to change. Unlike the Community Development Club, they were limited in membership to certain ages or sexes. In this study a neighborhood containing any of the above mentioned development organizations is referred to as an organized neighborhood.

**Method of Analysis and Limitations of Data**

The method of analysis used was to divide 15 sample neighborhoods into three groups: those with Community Development Clubs, those without Community Development Clubs but with other development organizations, and those with no development organizations, and then to compare the three groups to discover differences. The analytical design used was both cross-sectional, to compare present neighborhood differences, and longitudinal, to discover past differences leading to the formation of different interaction patterns in the different groups of neighborhoods.

The subsequent analysis is confined chiefly to the two polar types of neighborhoods, the Community Club neighborhoods in contrast to the unorganized. The other organized neighborhoods were a more heterogeneous group with characteristics of both polar types. The two in the isolated sections of the county, which had no adult organizations but only 4-H Clubs, on the whole, resembled the unorganized group. The large village-centered neighborhood and the large neighborhood adjacent to the county seat, which had both adult organizations and 4-H Clubs, more nearly resembled the Community Club group except for more nonfarm work and higher income.

The limited locality, the smallness o the sample, and the fact that data wer often inadequate because of being collected for other purposes[4] limit the value o this study largely to suggesting hypotheses rather than to their testing according to rigid statistical measures. The statistical measures used were proportions and measures of central tendency. Since th theory of experimental inference rests o the principle of randomization, and n randomization was possible in the selection of the neighborhoods studied, statistical tests of significance were not used.[5]

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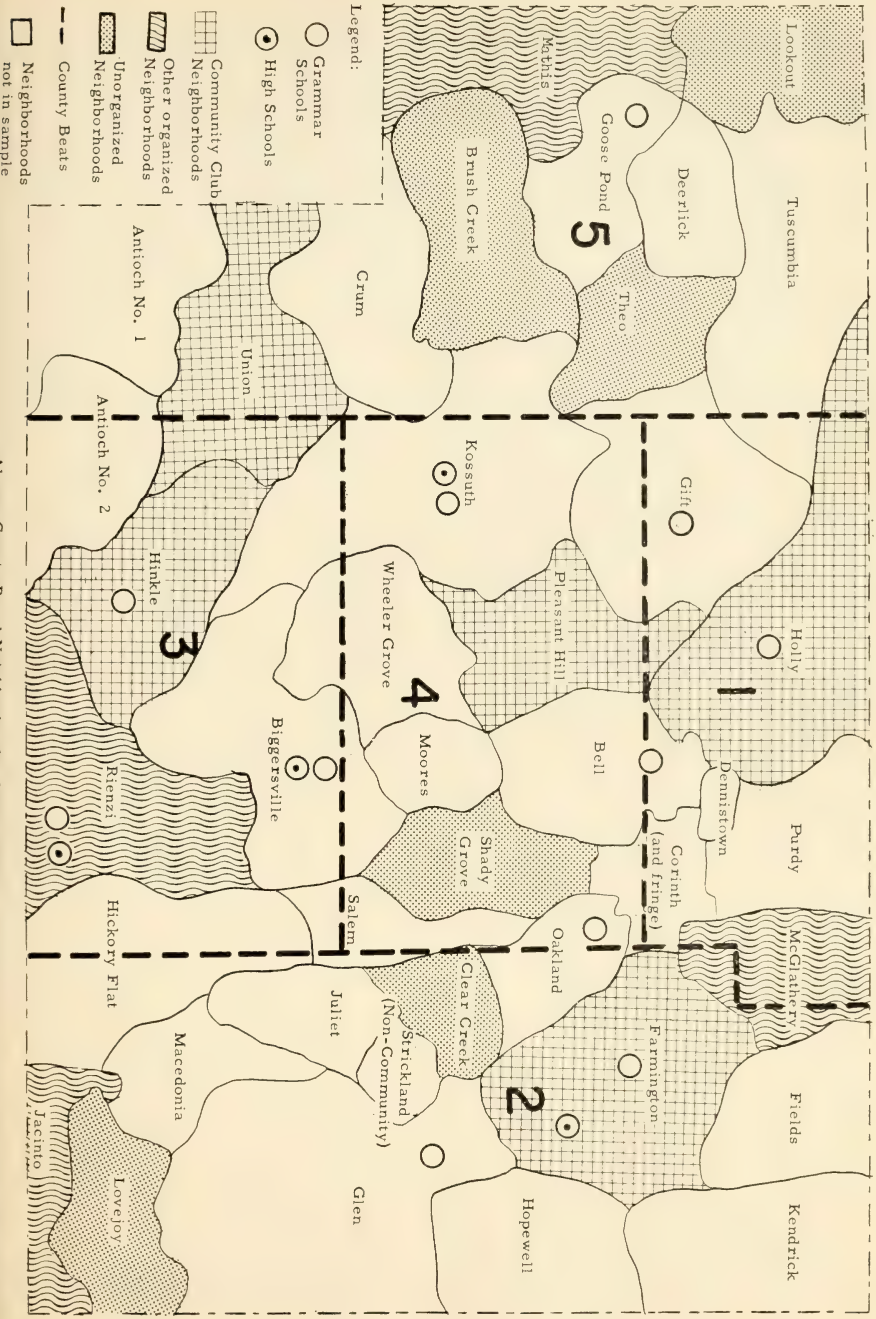
[4] Data for 1957 were secured from informa interviews by a field worker, Agricultural Extension Service employees, and Alcorn Count newspapers. Data for earlier years were fron publications of the Department of Sociology an Rural Life, Miss. AES, two surveys made by thi department, namely, the Alcorn County Surve of Part-Time Farmers and Rural Residents, 195 and the Alcorn County Survey of Adoption c Agricultural Practices, 1955, Alcorn Count school records, annual reports of County Agricultural Extension Agents, a 1924 county ma published by the USDA Bureau of Soils, an unpublished histories of Alcorn County found i the Corinth Public Library.

[5] Hanan C. Selvin, "A Critique of Tests ( Significance in Survey Research, **American Soc ological Review,** 22:5, 528-533 (Oct., 1957).


Legend:
○ Grammar Schools
⊙ High Schools
Community Club Neighborhoods
Other organized Neighborhoods
Unorganized Neighborhoods
County Beats
Neighborhoods not in sample
Lookout
Mathis
Goose Pond
Deerlick
Tuscumbia
Brush Creek
5
Theo
Crum
Union
Antioch No. 1
Antioch No. 2
Kossuth
Gift
Hinkle
3
Pleasant Hill
Wheeler Grove
4
Holly
1
Biggersville
Moores
Bell
Rienzi
Dennistown
Shady Grove
Corinth (and fringe)
Purdy
Salem
Hickory Flat
Oakland
McGlathery
Clear Creek
Juliet
Strickland (Non-Community)
Farmington
Macedonia
2
Fields
Jacinto
Glen
Lovejoy
Hopewell
Kendrick

Alcorn County Rural Neighborhoods, 1955-1958

Also, the number of cases was not large enough to control by cross tabulations all the important variables, so even if tests had been made, it would be difficult to draw correct inferences.

### The Alcorn County Neighborhoods and the Sample

Alcorn County lies in the northeast hill section of Mississippi. This geographic area, along with the rest of the state and much of the Southeast, has been designated as the low income problem area of the nation. In 1955, an experienced field worker and analyst, through interviewing county leaders and key informants, delineated 37 predominantly white rural neighborhoods and a locality known as Strickland, designated as a non-community area[6]. (See map). The accuracy of this delineation was confirmed by a response to an item on neighborhood name discussed in a subsequent section of this report. Distributed through approximately one-third of these neighborhoods were 14 Negro groupings which appeared as small clusters of scattered households in the much larger white neighborhoods. There was only one predominantly nonwhite neighborhood, Dennistown. Since the proportion of nonwhites in the county was so small, with 10 of the 14 groupings having less than 20 families, the nonwhite groupings were omitted from this study.

The sample for the study consisted of those 15 neighborhoods selected for the Alcorn County Surveys of 1955 and 1956. Judgment sampling was used, and the neighborhoods were selected in order to be representative of the county in terms of number of households, economic and public services, presence or absence of Community Development Clubs, and land use type.

## Economic and Population Characteristics

How people make a living and how well they live influence their social participation. Size of neighborhood population and drastic population change have also been found to influence social organization.[7] Clusters of economic and population characteristics are here examined to determine their influence on the social organization of the rural neighborhoods in Alcorn County.

### The Agricultural Enterprise

Since farming was the traditional major source of income in both Community Club neighborhoods and the unorganized neighborhoods, the level of the agricultural enterprise in each group was examined to detect differences. Table 1 reveals that both classes of organized neighborhoods had adopted a greater number of improved agricultural practices than the unorganized group. The Community Club neighborhoods on the average adopted 3.4 improved practices out of 5 in contrast to an average of only 1.3 adopted in the unorganized group. Where neighborhoods were largely dependent upon farming, the adoption of improved agricultural practices seemed of major importance in determining production and probably income from farm sources.

Community Club neighborhoods on th

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[6] Frank D. Alexander, **Rural Communities, Organized Groups, and Public Agencies in Alcorn County, Mississippi, in Relation to Community Development, Particularly Educational Programs Through Rural Community Clubs.** Sociology and Rural Life Preliminary Reports in Community Organization No. 2 (State College: Miss. Agr. Exp. Sta., 1955).

[7] Paul J. Jehlik and Ray E. Wakely found seven factors which modified rural organization: highly productive soil, history and tradition, communication and transportation, changing population characteristics, scientific and mechanized farming, and level of living. See **Rural Organization in Process, A Case Study of Hamilton County, Iowa.** Research Bul. 265 (Ames, Iowa: Agr. Exp. Sta., Sept., 1949), pp. 186-187.

hole had more of the better soil than e unorganized group. Three of the five ad over half their area in soil suitable r pasture in combination with row crops, ut only one of the unorganized had such high proportion of cultivable soil.[8] Half the other organized neighborhoods were the better soil area, and half had low- soil fertility. Table 1 shows little differ- nce in tenure, age, or years of residence the locality in the three classes of eighborhoods.

### ource of Income, and Education

When the source of income of Com- unity Club neighborhoods was compar- l with that of the unorganized group, e striking difference was in the amount work income. (See Table 1.) One-fifth the household heads in the unorganiz- l neighborhoods were not gainfully em- oyed, exactly twice as high a propor- on as in the Community Club neighbor- ods. In one of the unorganized neigh- rhoods about one-third of the families d no work income. The large propor- on of household heads not gainfully em- oyed in the unorganized neighborhoods rtially accounts for the low median fam- income, which was about three-fifths wer than in the Community Club oup. The greater amount of income the other organized neighborhoods is rgely explained by greater opportunity r non-farm work, especially in the large ighborhood adjacent to Corinth.

Male heads in the unorganized group neighborhoods had two years less of ucation than in the Community Club oup. Education is not only an impor- nt factor in explaining opportunity for inful employment and amount of in- me, but has also been shown to be high- correlated with level of living and par- ipation in organizations.[9]

### Socio-Economic Score Distribution

Socio-economic scores may be seen as an index to level of living and social participation.[10] The difference in Sewell socio-economic scores in the three neighborhood groups was revealed more clearly in the distribution of scores than in the median score shown in Table 1. Table 2 shows that 17 percent of Community Club households but only 3 percent of the households in the unorganized neighborhoods were in the highest category of scores. The proportion of Community Club neighborhood families represented in the club ranged from 16 to 28 percent. If these were the families of high socio-economic level indicated in Table 2, it might be implied that if around one-fifth of the families in a neighborhood had relatively high socio-economic srores, a club could succeed even though neighborhood families as a whole had low scores and a low income.

This conclusion was borne out by two examples. In one active neighborhood in the Community Club group the median family income was less than $700, but 19 percent of the households were in the highest socio-economic score category, while another 19 percent fell in the second highest category. In contrast, an unorganized neighborhood in the vicinity of Corinth had a median income of $2,000 (the second highest income of all sample neighborhoods), but the majority of the households fell in the medium low category of scores and only 8 percent in the highest. In the lowest income neighborhood there were evidently enough families of higher socio-economic status to form a nucleus for organizational membership while in the higher income neighborhood there were not.

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[8] Alexander, **op. cit.**, pp. 64-65.

[9] Raymond Payne and Harold F. Kaufman, **ganizational Activities of Rural People in Mis- ippi.** Circ. 189 (State College: Miss. Agr. p. Sta., Nov., 1953), p. 8.

[10] A sample of 1,043 adults from 552 rural families in four selected counties of Mississippi showed that these scores provided "clues to participation patterns," the higher the score, the larger being the proportion of persons belonging to organizations.

Table 1. **Economic and Population Characteristics of Neighborhood Residents by Kind of Organization for Rural Development, 1956.**[1]

| Economic and Population Characteristics | All Neighborhoods | Community Club Neighborhoods | Other Organized Neighborhoods | Unorganized Neighborhoods |
|---|---|---|---|---|
| Source of Family Income: | | | | |
| Percent from farming & part-time farming | 49 | 55 | 39 | 50 |
| Percent from non-farm work | 37 | 35 | 44 | 30 |
| Percent heads not gainfully employed | 14 | 10 | 17 | 20 |
| Median Family Income | $1215 | $1360 | $1681 | $823 |
| Median yrs. sch. completed | | | | |
| Male head | 8.2 | 8.1 | 8.4 | 6.3 |
| Female head | 8.6 | 8.7 | 8.7 | 8.2 |
| Median Sewell Socio-Ec. score | 70 | 72 | 71 | 67 |
| No agr. practices adopted | 1.8 | 3.4 | 2.6 | 1.3 |
| Median No. acres operated | 67 | 51 | 60 | 79 |
| Tenure: | | | | |
| Percent owners and owner-renters | 61 | 61 | 52 | 69 |
| Percent renters | 27 | 31 | 25 | 19 |
| Percent sharecroppers and laborers | 12 | 8 | 23 | 12 |
| Home practice score (perfect, 20) | 14.6 | 15.7 | 15.0 | 12.6 |
| Percent couples with children | 53 | 55 | 50 | 53 |
| Median size of household | 3.6 | 3.7 | 3.4 | 3.5 |
| Median age of male head | 48.9 | 48.1 | 49.7 | 49.3 |
| Median yrs. residence in neighborhood of household head | 22 | 21 | 20 | 25 |

[1] Source of Data: Alcorn County One-Third Sample. (Based on sample drawn from both Ado tion and Part-Time Farmer and Rural Resident Surveys).

Table 2. **Percent Distribution of Household Socio-Economic Scores in 15 Sample Neighborhoods, Organization for Development, 1956.**[1]

| Neighborhoods by Kind of Development Organization | Categories of Socio-Economic Scores<br>Low 39-61 | Medium Low 62-71 | Medium High 72-81 | High 82-91 | All 39-91 |
|---|---|---|---|---|---|
| | (Percent of Households) | | | | |
| All sample neighborhoods | 20 | 35 | 29 | 16 | 100 |
| Community Club neighborhoods | 17 | 33 | 33 | 17 | 100 |
| Other organized neighborhoods | 21 | 33 | 23 | 23 | 100 |
| Unorganized neighborhoods | 29 | 40 | 28 | 3 | 100 |

[1] The Sewell Socio-Economic Score was used.

**Population Characteristics**

Although Community Club neighborhoods varied widely in number of households, there was some relationship between number of families and neighborhood organization. The mean number and range of households in the three groups of neighborhoods were as follows:

| | Mean | Range |
|---|---|---|
| Community Club | 138.6 | 68-295 |
| Other organized | 133.5 | 41-207 |
| Unorganized | 53.3 | 32-92 |

While on the average the unorganized neighborhoods were smaller, the range, especially of the two organized groups, was tremendous. Table 3 seems to indicate that a minimum of around 20 families interested in organizational activty was necessary for the successful operaton of a Community Development Club. Whether or not a neighborhood had organization seemed to depend more on the number of families of a certain socio-economic level than on the total neighborhood population. For example, the number of families participating in Community Development Clubs was never any more than the number in the smallest neighborhoods. However, as shown previously, the economic and population characteristics of the smallest neighborhoods differed from those of the other two neighborhood groups. The small unorganized neighborhoods were characterized to the greatest extent by a combination of characteristics found to be least conducive to organizational interests, namely, poor land, lack of work income, isolated location, population loss, and a large proportion of families of low socio-economic level.

The distinction between number of neighborhood households and complexity of interests was found to be important[11]. When number of households was related to mean number of development organizations in Table 4, the larger neighborhoods had a greater number of organizations, but a higher percentage of the medium size neighborhoods had Community Development Clubs. In larger neighborhoods there is the problem of diverse interests and a tendency to divide into smaller groups[12] Table 3 shows that in largest Community Club neighborhoods the percent of families represented in development organizations was smallest in both the Community Club and Home Demonstration Club. Nevertheless, the Community Club was able to function effectively because a sufficient number of families were members, regardless of the proportion of neighborhood families participating.

Community Club neighborhoods on the whole had lost less population than the unorganized group. In the 1940-1950 census decade all three groups of neighborhoods showed little difference as to the number of neighborhoods gaining or losing population, but in the unorganized group population loss was much greater, amounting to approximately one-fifth in the three neighborhoods in Beat Five.

The 1960 census showed that all rural areas of the county had lost population, although some of the loss was due to the extension of the City of Corinth boundaries. Beat Five lost another one-fifth of its population, bringing the loss from 1930 to 1960 up to more than one-third of the 1930 population.

To summarize, the chief economic and population characteristics differentiating the Community Club neighborhoods from the unorganized group were the adoption of a greater number of improved agricultural practices, more work income, a greater number of school years completed, a larger proportion of families with relatively high socio-economic scores, and a less drastic population loss. If the above combination of characteristics is favorable, and there is a minimum of 15 to 20 neighborhood families interested in organizational activity, the prospect would seem favorable for the successful functioning of a Community Development Club.

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[11] The literature on neighborhoods has assumed a high correlation between strength of neighborhood and size, but this study did not reveal this to be necessarily true.

[12] Dorris Rivers, Extension Sociologist at Mississippi State University, has observed that it is often difficult for a Community Club to operate in a large neighborhood because of too much competition from special interest organizations. Also, in the Missouri Standard Community Program of the 1920's it was generally observed that clubs did not persist in hamlets because of competing organizations.

Thus far certain conditions have been examined which appear to be favorable to the kind of local interaction or activity necessary for a successful Community Development Club. The remainder of the report will deal with the interaction itself.

**Table 3. Number of Households in Five Sample Community Club Neighborhoods with Number and Proportion of Households Represented in the Community Club and the Home Demonstration Club, 1957.**

| Numer of Households | | In Community Development Club | | In Home Demonstration Club | |
|---|---|---|---|---|---|
| | | Number of Families | Percent of Families | Number of Families | Percent of Families |
| Total | 693 | 161 | 23 | 6 | 4 |
| | 295 | 47 | 16 | 24 | 8 |
| | 139 | 40 | 29 | | |
| | 111 | 26 | 23 | 20 | 18 |
| | 80 | 29 | 36 | | |
| | 68 | 19 | 28 | | |

**Table 4. Number of Households in Sample Neighborhoods with Mean Number of Development Organizations, and Number of Neighborhoods Having Community Clubs, 1957.[1]**

| Neighborhoods Grouped by Number of Households | Number of Neighborhoods | Mean Number of Organizations | Number of Neighborhoods with Community Clubs |
|---|---|---|---|
| All | 15 | 1.1 | 5 |
| 139-295 | 4 | 2 | 2 |
| 68-111 | 5 | 1.5 | 3 |
| 32-58 | 6 | 0 | 0 |

[1] Mean number of development organizations includes Community Development Clubs.

## Interaction Patterns Within the Neighborhood

Groups and associations within the neighborhood which promote interaction among the residents are the services through which common needs are met, such as school, church, post office or general store; organizations for solving common problems and fostering common interests; and informal groups.

### Neighborhood Services

**School:** A study of school districts and neighborhood boundaries in Alcorn County over a thirty-year period[13] indicated that school districts were originally formed on a neighborhood basis and that the school was regarded as a major neighborhood institution. In 1910, there were 71 white rural elementary schools in the county. By 1925 there were only 53 districts, but school names were still the same as neighborhood names. In 1955, there were 23 rural elementary schools and three high schools for the 37 rural neighborhoods, and school districts no longer corresponded to neighborhood boundaries. As shown by the map of the Alcorn County neighborhoods, by the late fifties the divorcement of school district from neighborhood boundary was complete, and there were only eight attendance units in the rural areas. The loss of this important neighborhood institution not only reduced the number of local services but also necessitated the forming of new relationships with other neighborhoods and with the county as a whole.

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[13] Wilfrid C. Bailey, "Changes in School Districts and Neighborhood Boundaries for a Thirty-Year Period in a Selected Mississippi County," **The School and Church in Community Improvement, Proceedings of the Tenth Annual Institute for Town and Country Church Leaders,** Mary B. Whitmarsh and Harold F. Kaufman, Eds. (State College: Miss. Agr. Exp. Sta., Sociology and Rural Life Conference Series 5, Feb., 1958), pp. 24-25.

A study of school records of the fifteen sample neighborhoods for seven selected years between 1905 and 1957 showed that schools were more often present in the Community Club neighborhoods than in the other two neighborhood groups. All but one of the Community Club neighborhoods had at least one school during the entire time, and this one retained its school until the 1930's. All but one of the other organized neighborhoods also had a school during the entire period, and this one was without a school for only two of the selected years. In the unorganized group, four of the six neighborhoods were without schools by 1957, and one in the vicinity of the county seat had never had a school.

**Church:** The rural church was the only neighborhood institution that had seemed to hold its own. At the time of this study churches were located in all rural neighborhoods in the county except four, and there was a total of 64 churches in the 37 neighborhoods. From 1942 to 1957 the number of rural churches increased 31 percent, although the rural neighborhoods during roughly the same period (1940-1960) lost 23 percent of their population. Table 5 shows that in the sample neighborhoods the mean number of churches over a time period was slightly higher in the Community Club group.

At the time of this study the service area of the rural church was only occasionally related to the area of organiza-

**Table 5. Mean Number of Churches in Three Groups of 15 Sample Neighborhoods for Selected Years Between 1921 and 1957.**

| Neighborhoods | 1921 | 1936 | 1942 | 1957 |
|---|---|---|---|---|
| All Neighborhoods | 2.2 | 2.2 | 2.2 | 2.6 |
| Community Club neighborhoods | 2.3 | 1.7 | 1.7 | 2.5 |
| Other organized neighborhoods | .6 | 1.0 | 1.0 | 1.5 |
| Unorganized neighborhoods | 1.7 | 1.6 | 1.6 | 2.1 |

**Table 6. Number and Percent of Families Attending Church Inside and Outside the Neighborhood in 15 Sample Neighborhoods, 1956.[1]**

| Number of Families and Percent Attending Church Inside or Outside the Neighborhood | All Sample Neighborhoods (15) | Community Club Neighborhoods (5) | Other Organized Neighborhoods (4) | Unorganized Neighborhoods (6) |
|---|---|---|---|---|
| Number of families | 487 | 227 | 160 | 100 |
| Number of families attending church inside or outside the neighborhood | 430 | 198 | 145 | 87 |
| Percent of families attending: | 100 | 100 | 100 | 100 |
| Inside neighborhood | 46 | 47 | 46 | 40 |
| Outside neighborhood | 54 | 53 | 54 | 60 |

[1] The following households were omitted: divided households where some members of the family attended church inside and others outside the neighborhood; families where household heads were not church members and did not attend regularly; and families on which no data could be obtained.

tion for rural development. According to Table 6, which shows that more families in all groups of neighborhoods attended church outside the neighborhood than inside, the church seemed to have become more of a special interest group than a locality group as might have been the case in the "horse and buggy days" of the last century. The fact that the percent of families attending church inside the neighborhood was slightly higher in the Community Club group may denote more vital local interaction patterns.

While usually the church seemed to have little influence on organization for rural development, there were exceptions. In one neighborhood the pastor was instrumental in organizing the Community Club, and in two neighborhoods church buildings were used as meeting places for the Community Club. On the other hand, in one small unorganized neighborhood with three churches, the churches were reported to be more of a divisive than a uniting influence.

**Economic Services:** Both groups of organized neighborhoods had more economic services than the unorganized.[14] All Community Club neighborhoods had one or more business establishments. The mean was 3.6, and the range from 1 in a medium size neighborhood to 8 in a large neighborhood in the vicinity of the county seat. In the four other organized neighborhoods the mean was 7.5 and the range from 2 in the smallest neighborhood to 17 in the village neighborhood. In contrast, only two of the six unorganized neighborhoods had business establishments, one with 2 and the other with only 1, making a mean of .5 for the unorganized group. Previous studies have shown that those neighborhoods with few or no services were the ones which became inactive.[15]

Voting precincts were found in all but one of each of the two organized groups of neighborhoods but in only two of the unorganized group. There were Agricultural Stabilization and Conservation Committees in all but one of the Community Club neighborhoods but in only one of the other organized neighborhoods and in only one of the unorganized group. These functions of government also increased contacts among local neighborhood residents.

**Informal Groups:** The old concept of "neighboring," which has long been considered a vital part of rural neighborhood interaction, in a day of modern transportation facilities and special interest groups no longer seems to assume its former importance. Scores for visiting, swapping labor, and aid in time of trouble were practically the same for all three groups of neighborhoods. Unfortunately, no data were available as to friendship cliques and kinship groups.

## Organizational Activity—Past and Present

### History, Neighborhood Organization[16]:

The organizational experience and the pronounced leadership patterns prior to the organization of the Community Development Club may be regarded as major factors in the establishment and success of the club. The Community Club neighborhoods had more significant histories, and with one exception (the village-centered neighborhood which was almost too large for a family-type organization such as the Community Club), there was no neighborhood with a history of strong organizational activity in whch a Community Club was not found.

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[14] Alexander, **op. cit.,** pp. 62-63. The data data were for 1954.

[15] Edmund deS. Brunner and J. H. Kolb **Rural Social Trends,** quoted in Dwight Sanderson, **Rural Sociology and Rural Social Organization** (New York: John Wiley and Sons, Inc. 1942), p. 69. Historical data were not available on economic services in the Alcorn County neighborhoods.

[16] Although information is undoubtedly incomplete, the authors feel that enough was found to support the hypothesis that the Community Club neighborhoods had more past organizational experience than the unorganized neighborhoods.

In the Community Club neighborhoods not only the present generation but their fathers had experience in working together at the neighborhood level and over a long period of time had built up what might be termed organizational "know-how." The mean number of different kinds of organizations prior to 1955 found in the three groups of neighborhoods was as follows:

| | |
|---|---|
| Community Club neighborhoods. . . | 4 |
| Other organized neighborhoods. . . | 4 |
| Unorganized neighborhoods. . . . . | 1 |

The organization most frequently found was the women's Home Demonstration Club, which at some time was present in all but one of the five Community Club neighborhoods, in all of the other organized neighborhoods, and in all but one of the unorganized group. While there was no appreciable difference as to the presence of this club in the three neighborhood groups, there was a great difference in its duration. In all of the Community Club neighborhoods the Home Demonstration Club had lasted over five years, but in only one each of the other two groups had it lasted so long. In half of the unorganized group it had lasted only one year. The duration of 4-H Clubs showed a somewhat similar trend. In both he Community Club group and the other organized neighborhoods there had been a 4-H Club for over five years, but in only two of the unorganized group had here been 4-H Clubs, which lasted only hree and four years, respectively.

Other organizations found in the five Community Club neighborhoods prior to 955 were the Parent-Teacher Association n three, Works Progress Administration Clubs in two, a Woodman of the World raternal organization in two, a Farmers' Union in one, a Masonic Lodge in one, a Girls' Poultry Club in one, and a neighborhood "Society" in one. The only organization other than the Home Demonstration Club and the 4-H Club found in the unorganized group of neighborhoods was a Woodman of the World Camp in one neighborhood. In the other organized group, only the small village neighborhood had had other organizations, namely a Parent-Teacher Association, a Lions Club, a Civic Club, a Canning Club, and a Works Progress Administration Club.

The existence of a strong interactional network in Community Club neighborhoods prior to the organization of the club is further indicated by the fact that the Home Demonstration Club women also became active members of the Community Club, and the two agencies worked together so closely that it was difficult to distinguish precisely between those activities carried out jointly and those performed by the two agencies separately.

Only one neighborhood in which a Community Development Club was formed did not at the time of its organization already have a development club of some kind, and in this neighborhood ten percent of the women were attending a Home Demonstration Club in an adjoining neighborhood, a fact indicating that the type of activity congenial to social organization was present.

**Neighborhood Development Activity in 1957:** The presence of a Community Development Club in a neighborhood was associated with extensive organizational activity. Out of 151 activities reported in the 15 sample neighborhoods in 1957, 109 were carried out in the Community Club neighborhoods as compared to 36 in the other organized neighborhoods, and only 6 in the unorganized group. Both the Home Demonstration Clubs and the 4-H Clubs participated in more activities in those neighborhoods with Community Clubs.

The Community Club neighborhoods not only carried out a greater number of activities but also more different kinds. Eleven different kinds of activites were carried out in the Community Club neighborhoods compared to seven kinds in the other organized neighborhoods, and three kinds in the unorganized group. In the unorganized group this type of activity was limited to mutual aid in time of trouble, an occasional church work day, and cemetery beautification.

**Leadership Perception:** It is commonly recognized that capable leadership is important in social organization and in carrying out planned development projects. In initiating the Community Development Club movement in the county in the spring of 1952, county seat leaders chose as the first neighborhood to be organized one known for its strong local leadership.[17] Where such leadership exists, there is likely to be some consensus among local residents as to who the leaders are. In the Community Club neighborhoods a higher proportion of both men and women recognized one, two, or three of top influence leaders than in the other neighborhood groups. (See Table 7). The low degree of leadership perception in the neighborhoods with other development organizations may be explained by a large neighborhood in the fringe area of Corinth which was gradually losing its identity and becoming absorbed by the city In this neighborhood more than half o the men and half of the women name no local leaders.

**Neighborhood Identity—Past and Presen**

Local services, local organizational activities, and local history help establis a neighborhood as a separate and uniqu locality group. Neighborhood identity wa measured by neighborhood delineation o maps of three different time periods,[1 the presence of news columns in th county paper, and recognition of neighborhood name.

A sampling of early maps, newspaper and other historical records revealed tha all the Community Club neighborhood existed during the past century, and o the whole, their boundaries had remained relatively stable throughout the years In only one of the neighborhoods had th name changed. Four of the five had new columns in the county paper as early a 1890. These columns reported neighborhood social affairs, school improvement fairs, and other educational events an programs.

All but one of the four other organize neighborhoods existed in Civil War day In all, boundaries had changed slightl In one the neighborhood had shifted mile east to take advantage of the rai road. While four of the six unorganize neighborhoods dated from the nineteent

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[17] Baird and Bailey, **op. cit.**, p. 7

[18] Agricultural planning maps of the late thirties and the late forties were compared with the map shown below. The accuracy of the data is questionable, since the method of delineating neighborhoods probably changed from time to time.

**Table 7. Leadership Perception by Male and Female Household Heads in Three Groups of Sampl Neighborhoods.[1]**

| | Percent of Male Heads in Three Groups of Neighborhoods | | | | Percent of Female Heads in Three Groups of Neighborhoods | | | |
|---|---|---|---|---|---|---|---|---|
| Names Mentioned | All | Community Club | Other Organized | Unorganized | All | Community Club | Other Organized | Unorganized |
| 1, 2, or 3 of top leaders | 59 | 71 | 44 | 55 | 56 | 69 | 37 | 54 |
| No names or none of top 3 leaders | 41 | 29 | 56 | 45 | 44 | 31 | 63 | 46 |

[1] Data were obtained by compiling replies to the following question: "Who is this communit would be the best people to go to if you wanted to get folks around here together to do somethin about bettering your community, such as improving the schools, churches, roads, etc.? (Try to ge at least 3.)"

century, only two had columns in the early newspapers examined, and one had a column for one year only. No mention could be found of the other two of the unorganized group until 1912 and 1930 respectively. Boundaries in the unorganized neighborhoods had not remained as stable as in the organized groups.

Neighborhood identity at the time of this study was measured by recognition of neighborhood name. In the different Community Club neighborhoods, from 90 percent to all of the residents correctly identified the neighborhood name, and in the other organized neighborhoods, with one exception the percent was almost as high. (The exception was a large neighborhood on the outskirts of Corinth, where only 60 percent identified the name.) In half of the unorganized, group identification scores were as high, but in the other half, relatively low. The two neighborhoods with the lowest scores (ranging from 60 to 70 percent) were in Beat Five, two of the same neighborhoods where no history could be found of past organizational activity.

All Community Club neighborhoods and all other organized neighborhoods except the village-centered one,[19] had society columns in the county newspaper in 1957. None of the unorganized group had a column, although news items from these neighborhoods appeared occasionally.

As evidenced by the data, the Community Club neighborhoods had long been recognized as centers of rural activity. As rural and urban interests began to merge, not only local activity but contacts with the county seat began to increase in importance. The following section of this report describes the nature of the participation of neighborhood residents in the larger trade area.

## Contacts Outside the Neighborhood

The county seat was found to be highly important as a trading and marketing center, an avenue of communication, a source of nonfarm employment, and a resource for rural development. At the time of this study there was no locality unit intervening between the neighborhood and the trade area community of Corinth.[20]

Corinth was the chief market for the agricultural products of the county, and residents of all but two of the 15 sample neighborhoods mentioned Corinth as the place where they did most of their buying. The county newspaper published there was received in every neighborhood in the county. Other agencies drawing rural residents to the county seat were the Northeast Mississippi Regional Library, the County Hunting and Fishing Club, the Public Welfare Department, the County Community Fund, the Public Health Department, and the county branch of the Mississippi Employment Service.

Of major importance in rural organization were the development agencies concentrated in the City of Corinth. Among these were the Alcorn County Chamber of Commerce, which promoted development in the entire trade area, and a number of civic clubs, which sponsored the local neighborhood development clubs. The Alcorn County Development Council, composed of both urban and rural members and serving as the overall coordinating and supporting agency for the Community Development Clubs, met in the county seat. Also located in Corinth were six agricultural agencies: the Agricultural Extension Service, the Agricultural Stabilization and Conservation Committee, the Farmers' Home Administration, the Federal Crop Insurance Agency, the Mississippi Forestry Com-

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[19] News from the village-centered neighborhood appeared chiefly in a newspaper outside the county.

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[20] Cf. Irwin T. Sanders and Douglas Ensminger, **Alabama Rural Communities, A Study of Chilton County.** Bul. No. 136 (Montevallo: Alabama College, July, 1940).

mission, and the Soil Conservation Service.

The county seat was observed to influence neighborhood organization in two ways: first, through the two-way activity or interaction patterns esablished between rural residents and county seat leaders; and second, by the geographic location of the neighborhoods in relation to the county seat.

## Contacts of Rural Residents with Couny Seat Leaders

The leaders of the Agricultural Extension Service, the federal agricultural agencies, the chamber of commerce, and the Alcorn County Development Council assisted in organizing neighborhood development clubs, and their judgment as to whether or not a neighborhood had the qualifications necessary for the success of the club was an important factor in neighborhood organization. If rural leaders called upon these agencies for assistance in effecting improvements in their home localities then their neighborhoods began to receive special attention from county leaders, and important two-way interaction patterns or channels of activity were formed beween the county seat and these rural localities. County seat leaders became familiar with these neighborhoods and alert to opportunities for offering their assistance.

When rural residents failed to take advantage of county development resources available to them by contacting county agency leaders, they naturally created the impression that they were uninterested in improving their localities and perferred no interference by outsiders in their affairs. It was the weak, declining neighborhoods especially in need of assistance where no interest was shown in development activities. Unless there is a reverse trend in these declining neighborhoods, present indications portend that these groupings will disappear as neighborhoods.

Table 8 shows the difference in contacts of residents of the different neighborhood groups with the County Agricultural Extension Service, an important county development agency which was also instrumental in assisting rural residents with the organization of Community Development Clubs. Neighborhood development organizations seemed easier to establish and maintain in those neighborhoods where families had frequent contacts with the Agricultural Extension Service personnel. Since all the development organizations with the exception of the one civic club were Extension associated, where contacts with this agency were lacking, there would seem to be little chance for a club to function successfully.

Both male and female household heads in the two groups of organized neighborhoods made more contacts with this agency than did household heads in the unorganized neighborhoods, although a higher percentage of families in the latter group were dependent on income from farming. The larger number of contacts with the Agricultural Extension Service in the Community Club neighborhoods as compared with the unorganized group also provides one explanation for the larger number of families in those neighborhoods which adopted the improved farm practices referred to previously.

Table 8. Percent of Household Heads Contacting County Agricultural Extension Service in Three Groups of Sample Neighborhoods, 1955.

| Household Heads | Percent Contacting County Agricultural Extension Service in Three Groups of Neighborhoods: | | |
|---|---|---|---|
| | Community Club | Other Organized | Unorganized |
| Male | 61 | 66 | 36 |
| Female | 30 | 19 | 7 |

## County Seat Influence and Neighborhood Location

When neighborhoods had no strong organization of their own, it was observed that their geographic location might be unfavorable to neighborhood organization if they were either too far from the county seat or too near it. Geographic isolation as a single factor seemed to show little relationship to neighborhood organization, but when it was combined with other unfavorable situational factors—such as lack of opportunity for nonfarm employment, infertile soil, limited education, low income, low socio-economic level, small number of households, and population loss — a configuration was formed which seemed to sharply constrict organizational effort.[21]

Geographic accessibility to the county seat was measured by distance, paved roads, and transportation facilities. The map shows that three of the five Community Club neighborhoods were relatively near the county seat. The one in the remote area in Beat Five was the last to be organized. Three of the six unorganized neighborhoods were in this beat, and a fourth was as far removed in another direction. Nevertheless, residents in all but two of the unorganized group reported doing most of their buying in Corinth, which seems to indicate that enough county contacts would have been possible for organizing a club, had other characteristics conducive to neighborhood organization been present.

The other two unorganized neighborhoods were both near the county seat and on paved roads. Both were without services and might be termed nominal neighborhoods. None of the Community Club neighborhoods but half of the other organized neighborhoods and half of the unorganized were on regular interstate bus lines, but in only one was there a bus stop. The lower income of the unorganized group (see Table 1) might mean

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[21] James E. Montgomery in "Three Southern Appalachian Communities: An Analysis of Cultural Variables," **Rural Sociology,** 14, 2 (June, 1949), pp. 138-148, by matching natural resources in three communities found that isolation was an important factor in retarding neighborhood change.

**Table 9. Percent of Sample Neighborhoods with Selected Transportation Facilities, by Organization for Rural Development, 1955.**

| Groups of Neighborhoods | On Paved Road | School Bus Used for General Transportation |
|---|---|---|
| All sample neighborhoods | 60 | 60 |
| Community Club Neighborhoods | 40 | 60 |
| Other organized neighborhoods | 75 | 100 |
| Unorganized neighborhoods | 67 | 33 |

**Table 10. Percent of Household Heads Belonging to Secular Organizations in Three Groups of Sample Neighborhoods, 1956.**

| Household Heads n Secular Organizations | Percent of Household Heads Belonging to Secular Organizations in Three Groups of Neighborhoods | | |
|---|---|---|---|
| | Community Club Neighborhoods[1] | Other Organized Neighborhoods | Unorganized Neighborhoods |
| Total[2] | 28 | 18 | 12 |
| nside neighborhood | 18 | 6 | 0 |
| Outside neighborhood | 14 | 13 | 12 |

[1] These data were secured prior to the organization of the last Community Club, so the table hows only four Community Club neighborhoods instead of five.

[2] Since the same persons often belonged to secular organizations both inside and outside the neighborhood, the total of the two categories is not the same as the total for family heads belonging o secular organizations.

fewer automobiles for private transportation, but the public transportation facilities shown in Table 9 were no more favorable in the Community Club neighborhoods than in the unorganized.

**Participation in Secular Organizations Outside the Neighborhood**

The position has frequently been taken that strong neighborhood life prevents participation in the trade area and also at state and national levels. This study seemed to indicate that the stronger the neighborhood life, the more likely were the residents to participate in secular organizations both inside and outside the neighborhood. Table 10 shows that Community Club families belonged to more secular organizations both inside and outside the neighborhood than did the residents of the other neighborhood groups.

The leaders in the Community Club neighborhoods seemed to relate themselves to the larger trade area community, thus increasing their opportunities for economic, educational, and social development. The three top influence leaders named in one Community Club neighborhood had held offices in county, state, and national improvement organizations and had also won recognition in contests for farm and home improvement.

The three groups of neighborhoods could be differentiated not only by the number of outside secular memberships but also by the kind of outside organizations in which these memberships were held. Table 11 shows that residents of Community Club neighborhoods belonged chiefly to development or special interest organizations, while those of the unorganized neighborhoods belonged mainly to fraternal and patriotic groups. Nine residents of Community Club neighborhoods were officers or committeemen in the county development organizations, while only one in the other organized neighborhoods and none in the unorganized group held such positions.

The effect of outside participation on neighborhood life appears to depend on the strength of local organization. Two large neighborhoods bordering on the county seat provide cases in point. One of these had remained strong and active, carrying out development activity through a Community Development Club, a Home Demonstration Club, and a 4-H Club, yet 36 percent of the family heads belonged to secular organizations outside the neighborhood and only 30 percent to local organizations.

In the other, there was little interest in neighborhood development. Twenty-six percent of the family heads belonged to outside organizations, and only 5 percent to the one development organization for adults, which was a women's Home Demonstration Club. This club was not designated by the neighborhood name, and its membership was composed largely of county seat residents with rural members in the minority. The neighborhood was rapidly losing its identity and becoming absorbed into the county seat.

**Table 11. Percent of Households in Three Groups of Sample Neighborhoods Participating in Different Kinds of Outside Secular Organizations, 1957.**

| | Percent of Households Participating | | |
|---|---|---|---|
| Kinds of Outside Secular Organizations Participated in | Community Club Neighborhoods | Other Organized Neighborhoods | Unorganized Neighborhoods |
| Farm Bureau | 14 | 6 | 10 |
| County Cooperative[1] | 27 | 15 | 21 |
| Special Interest and Development | 6 | 6 | 1 |
| Fraternal and Patriotic | 9 | 20 | 14 |

[1] It was discovered that anyone buying as much as $25 worth of goods from the County Cooperative was listed as a member, so membership in this organization was no measure of a desire for agricultural improvement. While advice could be secured at the Cooperative in regard to seed, feed and fertilizer, some farmers bought these things there merely because they found it more economical to do so.

ULLETIN 626 JULY 1961

## n Economic Analysis of Factors Affecting

# Water Loss In Irrigation Channels
# n The Yazoo-Mississippi Delta

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director

TATE COLLEGE MISSISSIPPI

MISSISSIPPI STATE UNIVERSITY

## Summary

It has been found that evaporation and seepage of irrigation water in some areas can increase the cost of irrigation water delivered to the field.

To determine if evaporation and seepage were important factors in water cost in the Mississippi Delta, water losses were measured in irrigation channels in sandy, loam, and clay soils.

Due to peculiarities in these soil types it was found that the greatest losses were in clay soils and the smallest losses were in sandy soils. Extreme cracking in the clay soils caused higher losses, while a high percentage of silt in sandy soils causes a sealing which reduces water seepage in these soils.

Evaporation from irrigation channels was found to be of little significance.

When the low cost of pumping water in the area is taken into consideration, it becomes apparent that transportation systems which would reduce or eliminate the high water losses found in clay soils cost more on an annual basis than the value of the water lost during an irrigation season.

Pumping costs would need to increase considerably before it would pay to install distribution systems to prevent these losses.

# AN ECONOMIC ANALYSIS OF FACTORS AFFECTING WATER LOSS IN IRRIGATION CHANNELS IN THE YAZOO-MISSISSIPPI DELTA

By FRED T. COOKE, JR.[1]

One of the most important costs associated with irrigation is that of pumping and transporting water. The cost of irrigation water which reaches the field is increased due to evaporation and seepage. This study was undertaken to determine the extent of these losses in various soil types and to determine if they are great enough to justify replacing open unlined channels with lined channels or pipe.

Portable Parshall flumes were constructed to measure water in irrigation channels. The flumes were able to measure volumes of water ranging from 150 to 4,018 gallons per minute with a fairly high degree of accuracy. Flumes were used because it is possible to accurately measure the wide range of water volumes which are encountered on Delta farms. Also, most water channels in the area have little head or slope and flumes can be used under these conditions much better than weirs.

## Three Soil Groups Studied

Three general soil groups were considered in the study—sandy soils, loam soils, and clay soils. The soil classifications were made from Soil Conservation Service maps.

The clay soils consist of clay and silty clays and other soils that have similar characteristics. These soils include Sharkey Clay, Alligator Clay, and Dowling Clay. The clay soils in the area are composed of montmorillonite clay which expands greatly when wet. When these clays dry out cracks are formed and water passes through them readily. These cracks close very slowly in irrigation channels due to exposure to air and sunlight. On soils of this type, observations made in channels that had been wet for several weeks showed losses about the same as in channels that had been wet only a few days.

The loam soils are made up of silt loams, silty clay loams and other similar soil types and include Forrestdale silt loam, Forrestdale silt clays, and Dundee silty clay loams. Usually they have poor to fair internal drainage and generally have a silt loam top soil with a clay or silt loam subsoil. These soils also tend to crack like the clay soils but not to such a great extent due to a high percentage of silt present. Water losses in these soils are greater than that in sandy soils but not as great as in the clay soils.

The sandy soils consist of fine sandy loams, loams and silt loams. Some of ti more common soil series included in this group are Boskett silt loam, Boskett loam, Boskett fine sandy loam, Pearson silt loam, Dundee silt loam, and Dundee fine sandy loam. These soils are well drained, medium to course textured, lend themselves well to high levels of inputs, and are extremely well adapted to row cro production. These soils should probably be called fine sandy loams because they have less sand and more silt in them than sandy soils in other areas. The silt in these soils causes a sealing or crusting effect when they become wet. This sealing results in a very small amount of seepage.

## Two Kinds of Channels Tested

The channels used to transport water were of two kinds — ditches and flumes.

For the purpose of this study a ditch is defined as a channel which transports water below the surface of the ground and a flume is defined as a channel which transports the head of water above the ground surface.

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[1] Agricultural Economist, Farm Economics Research Division, located at the Delta Branch, Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

This report is a part of a larger study of supplemental irrigation in the Yazoo-Mississippi Delta being conducted by the Farm Economics Research Division, ARS, the Department of Agricultural Economics, Mississippi Agricultural Experiment Station, and the Delta Branch, Mississippi Agricultural Experiment Station.

The great majority of the ditches were "V" shaped while the flumes were about evenly divided between "V" and rectangular shape. Only channels with a surface width of 4 to 6 feet were measured due to limitations of the flume. To measure the flow of water in the irrigation channel Parshall flumes were spaced 1,000 feet apart. The water loss is reported as percent of volume lost per 1,000 feet of channel. Table 1 presents the water loss due to evaporation and seepage associated with the various soil groups included in the study.

It had been felt that the flumes would show greater losses due to seepage than ditches. The study indicated that there was no significant difference in losses in either type channel. Shape or type of construction had no apparent affect on water loss in the channels studied.

### Evaporation

Studies of evaporation in the Mississippi Delta have been carried on by the U. S. Weather Bureau at Stoneville, Mississippi.[2] This work indicates that the evaporation from a 4-foot wide irrigation channel would constitute 0.6 percent of the volume flowing during the most common irrigation period, July 15 to August 15.

It is evident from this that evaporation accounts for a large part of the water loss in sandy soils but constitutes only a small proportion of the total loss in loam and clay soils.

### Cost of Water

To determine the value of the water which is lost in irrigation channels a cost must be assigned to water which is used for irrigation. The cost of pumping water from wells with electric motors, the most common source of power, in the Mississippi Delta was $0.47 per acre inch for wells of the capacity found in this study[3]. Table 2 presents the value of the water lost from a well delivering 904 gallons per minute or 2 acre inches per hour if the well were operated 512 hours, the average number of hours operated annually[4], and one mile of channel was used.

To analyze the feasibility of reducing or eliminating water loss the clay soil situation will be used as water losses are the greatest in these soils. If the alternative transport systems do not prove to be economical in clay soils, then these systems cannot be economical in soils which have less seepage. Three alternative methods of transporting water are compared. These three examples are for illustrative purposes only. The three systems of transportation compared are an unlined channel, aluminum pipe, and a concrete lined irrigation channel. The costs of these systems are presented in table 3.

The first transportation system considered is an unlined irrigation channel. For this example it is assumed that the ditch is constructed with a motor patrol. A charge for land rent is included. However, this charge would not be applicable if the channel were constructed in the field turn-row. It has been found that 12 feet of right-of-way is needed for a ditch 4 feet wide, therefore 1.45 acres of land would be required for a ditch one mile long.

### Aluminum Pipe

One way to eliminate the loss of water

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[2] "Climate of the Delta Area of Mississippi," Riley, J. A. Mississippi Agricultural Experiment Station Bulletin 605, September 1960.

[3] "Investment and Operating Costs of Irrigation in the Delta Area of Mississippi." A progress report by Thomas E. Tramel, Grady B. Crowe, and J. F. Able, Jr., Mississippi Agricultural Experiment Station Bulletin 559. 1958.

[4] Ibid.

in the channel would be the use of portable aluminum pipe. It is assumed that only one-half mile of aluminum pipe would be required to replace one mile of channel. The pipe could be run one-half mile from the source of water in one direction and one-half mile in the other. This cannot be done with open ditches because of topography.

The smallest practical size aluminum pipe which could carry a volume of 904 gallons of water per minute is 8 inches in diameter and would cost $2.02 per foot. When water is moved through pipe the volume of flow is reduced because of friction. In this example a relift pump which can deliver a pressure of 39 pounds per square inch is necessary to force the required volume through the pipe. When tractor power is used it costs about $0.66 per acre inch to pump water with a relift pump of this size.

A six-foot lane is usually required to lay this pipe and thus a land charge of 0.73 acres must be made. The cost of the pipe is depreciated over 10 years in this example. The cost of laying and moving the pipe has been omitted from the example as this varies from season to season but should be taken into consideration when comparing systems.

### Concrete Lining

Another possible method of reducing water loss is lining channels with concrete. Very little of this has been done in the Mississippi Delta and information is limited. These channels cost $1.25 per foot to build. No maintenance costs are included in the example because there is little or no information on this subject. It is known that a certain amount of patching and filling of cracks is necessary every year. This would add to the yearly cost of this type distribution system. The expected life of these channels is unknown in clay soils but would probably be somewhat less than concrete lined channels in sandy or mixed soils due to cracking and heaving of the soil.

These channels are permanent and could interfere with the use of equipment in the fields. A charge for land rent is much more applicable for the permanent channels. The temporary channel may be constructed on the turnrow and would not necessarily require additional land as would the permanent concrete channel. A life of 20 years is assumed for this channel but this may be too long in clay soils

### Costs Exceed Returns

These three examples indicate that the cost of preventing water losses in irrigation channels in clay soils exceeds the cost of the water loss. The depreciation on investment for aluminum pipe or concrete lined channels would go on in years in which no irrigation would be needed, and this would increase the cost of the systems for the years used. With temporary ditches there would be no cost in years when irrigation was not needed because no ditches would be constructed.

The cost of pumping water would have to increase substantially before the installation of a system to reduce these losses would be economically sound. It should be emphasized that if the concrete ditch should have a shorter life than 20 years then the cost of this system would go up considerably.

Most irrigation channels in the Mississippi Delta are found in sandy and mixed soils because most irrigated row crops are grown on these soils. The water losses in these soils are less than in clay soils and the need to reduce this loss is correspondingly less. Most rice production is on clay soils and these losses could become significant.

### Other Water Losses

With irrigation, water is also lost when channels overflow or break. These losses seldom amount to a great deal of water in terms of dollars and cents but greatly add to labor cost. With pipe or lined ditches these losses are negligible. It has been found that these losses can be greatly reduced in unlined channels if care is taken in their construction.

The most common cause of breaking and overflowing channels is poor engineering in locating the channel. Care must be taken to follow the natural slope in laying out the channel. All low or high points should be marked so appropriate cuts and fills can be made. Little of this is necessary in most instances in the Delta.

When flumes are used, trash and sticks in the banks often cause breaks. This can usually be eliminated by thorough disking before the ditch is constructed.

Few farmers in the area prime their ditches before they are used but this would greatly reduce overflowing and breaks. Priming helps seal the ditch and if an overflow or break occurs the well can be cut off and the break fixed before the actual irrigation work begins.

**Table 1. Average water loss in unlined irrigation channels by soil groups.**

| Soil group | Number of observations | Average percent of volume lost per 1000 feet | Range of losses per 1000 feet (percent of volume) |
|---|---|---|---|
| Sandy | 34 | 1.3 | 0.6 — 5.0 |
| Loam | 17 | 6.8 | 3.7 — 8.8 |
| Clay | 23 | 9.8 | 5.1 — 19.5 |

**Table 2. Amount and value of water lost in one mile of irrigation in sand, loam, and clay soils.**

| Item | Unit | Sand | Loam | Clay |
|---|---|---|---|---|
| Discharge at well | GPM | 904 | 904 | 904 |
| Percent loss per 1000 feet | Pct. | 1.3 | 6.8 | 9.8 |
| Volume of water pumped in 512 hours | Acre in. | 1024 | 1024 | 1024 |
| Value of water pumped in 512 hours | Dol. | 481.28 | 481.28 | 421.28 |
| Discharge at end of one mile of unlined channel | GPM | 841.81 | 623.89 | 524.95 |
| Volume lost in 512 hours | Acre in. | 71.68 | 317.44 | 430.08 |
| Value of water lost | Dol. | 33.69 | 149.20 | 202.14 |

**Table 3. Annual cost of transporting irrigation water one mile by selected methods.**

| | Transportation method | | |
|---|---|---|---|
| Item | Temporary channel on clay soils | 8-inch aluminum pipe[1] | Concrete-lined irrigation channel[1] |
| | **Dollars** | **Dollars** | **Dollars** |
| Construction and maintenance | 66.04 | — | — |
| Closing ditch | 30.00 | — | — |
| Value of water loss | 202.14 | — | — |
| Land rent @ $7.00 per acre[2] | 10.15 | 5.11 | 10.15 |
| Maintenance and depreciation | — | 533.23* | 330.00** |
| Relift cost | — | 675.84 | — |
| Value of water loss due to evaporation | — | — | 15.15 |
| Total | 308.33 | 1,214.23 | 355.25 |

[1] 1.45 acres of land is required for one mile of temporary or concrete-lined irrigation channel.

[2] Land rent charge of $7.00 per acre is an arbitrary one and should be varied under different circumstances.

*Original costs and life. **Original costs and life.

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BULLETIN 627 AUGUST 1961

# Part-Time Farming

## Its Role and Prospects in the Clay-Hills Area of Mississippi

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HENRY LEVECK, Director
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In Cooperation with the Farm Economics Division
Economic Research Service, U. S. Department of Agriculture

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The data presented in this study are taken from a field survey of 517 rural families in the Clay-Hills Area of Mississippi completed in the Spring of 1958. A more complete description of these families is given in, "Incomes, Resources, and Adjustment Potentials of Rural Families in the Clay-Hills Area of Mississippi", AEc. M. R. No. 29, Mississippi Agricultural Experiment Station, **Nov.**, 1960 and "Incomes and Resources of Rural Families in the Clay-Hills Area of Mississippi, Mississippi Agricultural Experiment Station Bulletin No. **604**, September, 1960. This study is part of the research conducted in support of the Rural Areas Development Program.

# Summary

## The Role and Prospects of Part-Time Farming

The number of part-time farmers in the Clay-Hills Area of Mississippi has been increasing, while the number of full-time farmers and the total rural population has been decreasing. These trends may continue indefinitely.

In 1958, three-fourths of the average part-time farmer's net family money income came from off-farm work, about 20 percent from the farm, and the remaining 5 percent from nonwork sources. The average net family money income was $2,435.

Over two-fifths of the part-time farmers had net farm incomes of less than $250, and one in three had negative net farm incomes. Those operators with negative farm incomes could have increased their money incomes simply by not farming.

Over a third of the operators used only workstock in their farm operations. A majority of the operators who purchased tractors and equipment were able to do so because of their off-farm work income. Over a third of the farmers with tractors had negative net incomes but their net family money incomes were relatively large.

The average net money income of part-time farmers per hour of work was $.61. However, their average income from farm work was only $.17, while their average income from off-farm work was $1.02 per hour employed.

The occupational experiences of the family heads followed three general patterns: (1) school to farm to part-time farm (57 percent), (2) school to part-time farm (22 percent), and (3) school to off-farm to part-time farm (21 percent).

About one-third of the operators reported that they would look for nonfarm jobs if their present nonfarm employment were terminated. Another 28 percent said they would probably start farming full time. The rest were undecided as to what they would do.

Part-time farmers had almost the same average yields per acre of crops as did the full-time farmers in the area, but because of the smaller acreage, total production per farm was smaller. Cotton was the most important cash crop and dairying the most important livestock enterprise. Sales of beef cattle were also important. Cash farm receipts for part-time farmers averaged about $1,300, approximately half that of full-time farmers. On the average, cash farm expenses of part-time farmers were 64 percent of their cash farm receipts.

In general, capital was limited for part-time farmers in the Clay-Hills Area of Mississippi. The average investment per farm was a little over $8,000 and the average net worth was about $7,300.

Generally, part-time farmers use their farm resources less efficiently than do full-time farmers. This is borne out by both the computed returns per hour of labor employed on the farm and the ratio of farm expenses to farm receipts.

Evidence from this study indicates that many families use part-time farming as an intermediate stage to move out of full-time agriculture, either to full-time nonfarm work or to retirement. A smaller, though nonetheless substantial group, use part-time farming as a stage in moving into a semi-retired group of full-time farmers.

The role of part-time farmers

(and part-time farming) will likely remain important in the Clay-Hills Area of Mississippi in the future. In all probability, off-farm work will continue to be a major source of income to farmers.

For those families who wish to remain in agriculture, combining off-farm employment with farming may provide a satisfactory level of living. However, full-time nonfarm employment may yield a higher money income.

# Part-Time Farming

## Its Role and Prospects in the Clay-Hills Area of Mississippi

Herbert Hoover* and John C. Crecink*

## INTRODUCTION

Relatively more and more farm families in the Clay-Hills Area of Mississippi[1] are seeking off-farm employment to supplement their incomes; increasing numbers are becoming part-time farmers. Evidently, income from farming has not been adequate to allow these families to attain the desired level of living, and consequently, they have chosen part-time farming as an alternative.

Although in the last 20 years, the total number of farms in the Clay-Hills Area has declined steadily, the number of part-time farms has increased. In 1950, the part-time farm group as defined by the census made up only a fifth of the total number of farms in the area, but by 1959, the proportion had increase to almost half of the total (Table 1). This increase in the number of part-time farms came about despite a 33-percent decrease in the total number of farms. Part-time farms may continue to increase relatively, even though the total number of farms continues to decrease.

### Purpose and Method

The purpose of the study reported was to investigate the role of part-time farming and the prospects of the part-time farm group

Table 1. **Part-time farms: Number, percentage of all farms, and percentage of land in farms, Clay-Hills Area of Mississippi, 1950 and 1959.**

| | | Part-time farms | | |
|---|---|---|---|---|
| Year | Total number of farms | Number | Percentage of all farms | Percentage of total land in farms |
| 1950 | 52,027 | 10,601[1] | 20 | 24 |
| 1959 | 34,871 | 16,337[1] | 47 | 42 |

[1]Estimates of part-time farmers as defined in this study were derived from 1954 and 1959 Census of Agriculture data.

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*Agricultural Economist, Farm Economics Division, Economic Research Service, U. S. Department of Agriculture, cooperating with the Mississippi Agricultural Experiment Station.

[1]Census economic areas 4 and 6b, comprised of Alcorn, Calhoun, Choctaw, Clarke, Itawamba, Jasper, Kemper, Lafayette, Lauderdale, Newton, Pontotoc, Prentiss, Tippah, Tishomingo, Union, Wayne, Webster, and Winston Counties.

in the agricultural economy of the area. To assess the economic position of part-time farmers, resource use, family characteristics, and off-farm employment opportunities of the group were investigated.

For purposes of the study, farms were classified as part-time if: (1) An actual farm operation was conducted and gross farm sales were in excess of $150; and (2) the farm operator or some member of his family was employed off the farm 100 days or more.[2] Under this definition, part-time farm families fell into three groups. In addition to farming, either (1) the head of the household worked off the farm or (2) some family member other than the head worked off the farm, or (3) both the head and other family members were employed off-farm. Family heads in the first and third groups include the true part-time operators. For the most part, it is these groups that are analyzed in this report. Under this restricted definition, approximately one in five Clay-Hills farmers were part-time operators in 1958. The second group was not considered because for all practical purposes, it is made up of full-time farmers.

## Family Characteristics

Part-time farm families were classified into three types according to age and sex of the household head and employability of other family members. More than half of the part-time farm families (53 percent) had male heads of households 45 to 64 years of age with no occupational handicaps (Type II, Table 2). Only two in five of the part-time farm family heads were under 45 years of age and had no occupational handicap (Type I families). Seven percent of the families had female household heads, or the male head was 65 years of age or older (Type III families).

The average part-time farm family had 4 members, of which 2 were usually children. Part-time farm operators averaged about 48 years of age, and their educational level was 8 years of formal schooling. However, the youngest household heads usually had higher levels of formal education than the older family heads.

## Farm Characteristics

The average part-time farm in the Clay-Hills was relatively small (Table 3). Average farm size was approximately 72 acres, and less than a third of this (20 acres) was cropland.

Seven in ten of the part-time farms were classified as cotton farms and one in ten as cash grain farms. Only about one in twenty could be classified as a livestock farm. One possible reason for this low percentage of livestock farms may be the relatively small size of farm.

In general, farms in the Clay-Hills Area had a low level of mechanization. For instance, slightly over a third of the part-time farms had workstock as their only source of farm power. Reasons usually given for this low level of mechanization were the small acreages of cropland, the rather hilly topog-

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[2] This definition departs from the definition of part-time farms as used in the 1954 Census of Agriculture, where they were defined as: "Farms with a value of sales of farm products of $250 to $1199 were classified as part-time if the farm operator reported (a) 100 or more days of work off the farm in 1954, or (b) the nonfarm income received by him and members of his family was greater than the value of farm products sold".

**Table 2. Number and percentage distribution of 58 part-time farm families, by family characteristics, Clay-Hills Area of Mississippi, 1958.**

| Specified family characteristics | Part-time farm families Number | Percent |
|---|---|---|
| Total | 58 | 100 |
| Type of family[1] | | |
| I | 23 | 40 |
| II | 31 | 53 |
| III | 4 | 7 |
| Size of family | | |
| 2 | 11 | 19 |
| 3 | 14 | 24 |
| 4 | 14 | 24 |
| 5 and over | 19 | 33 |
| Age of family head | | |
| Under 35 | 8 | 14 |
| 35 to 44 | 15 | 26 |
| 45 to 54 | 16 | 27 |
| 55 to 64 | 16 | 28 |
| 65 and over | 3 | 5 |
| Education of family head | | |
| Under 4 | 7 | 12 |
| 5 to 8 | 28 | 48 |
| 9 to 11 | 11 | 19 |
| 12 and over | 12 | 21 |

[1] Family Type I includes all families with the male of the household under 45 years and no occupational handicap, and with or without other employable males 18 to 64 years of age; Family Type II includes all families with a male head 45 to 64 and no occupational handicap and with or without other employable males 18 to 64; Family Type III includes all households without an employable male 18 to 64 years of age.

**Table 3. Number and percentage distribution of 58 part-time farm families, by farm characteristics, Clay-Hills Area of Mississippi, 1958.**

| Specified farm characteristic | Part-time farm families Number | Percent |
|---|---|---|
| Total | 58 | 100 |
| Type of farm | | |
| Cotton | 41 | 71 |
| Cash grain | 6 | 10 |
| Livestock | 3 | 5 |
| Miscellaneous | 8 | 14 |
| Size of farm (cropland acres) | | |
| 1 to 19.9 | 29 | 50 |
| 20 to 29.9 | 18 | 31 |
| 30 to 69.9 | 8 | 14 |
| 70 and over | 3 | 5 |
| Type of farm power used | | |
| No workstock or tractor | 3 | 5 |
| Tractors only | 21 | 36 |
| Workstock only | 21 | 36 |
| Workstock and tractor | 13 | 23 |
| Tenure | | |
| Owner-operator | 34 | 59 |
| Tenant-operator | 14 | 24 |
| Owner-operator rent in | 6 | 10 |
| Owner-operator rent out | 4 | 7 |

raphy throughout the area, and the crops grown. Another three-fifths used either tractors or a combination of tractors and work-stock.

Over three-fourths of the part-time farmers owned their farms. Only a few (10 percent) of these operators rented in any additional land. About a fourth of the part-time farms were tenant operated.

## Income Relationship of Part-Time Farmers

In 1958, part-time farm families received net money incomes[3] ranging from $300 to $6,100, and averaging $2,435 (Table 4). On the average, approximately $1,843, or 76 percent, of this income was

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[3]Net family money income is the total income of all family members from: (1) Nonfarm employment, (2) Wage work on other farms, (3) Non-work income and (4) Net income from farming.

**Table 4. Source of income and average per family, 58 part-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Source of income | Average family income |
|---|---|
| | (dollars) |
| Farm | |
| Net cash receipts | 1,270 |
| Net cash expenses | 810 |
| Net cash income | 460 |
| Value of perquisites[1] | 386 |
| Depreciation on machinery and equipment[2] | 207 |
| Noncash farm income | 179 |
| Gross farm income | 639 |
| Interest on investment[2] | 353 |
| Net farm income[3] | 286 |
| Nonfarm | |
| Operator | 1,646 |
| Other family members | 197 |
| Total nonfarm work receipts | 1,843 |
| Transportation cost | 235 |
| Net income from nonfarm work | 1,608 |
| Nonwork[4] | |
| Transfer payments | 119 |
| Other | 13 |
| Total non-work income | 132 |
| Net family income (money and non-money) | 2,026 |
| Net family money income[5] | 2,435 |

[1]House rental was not included in computing farm returns because of the arbitrary way in which the value of rent was derived. However, the rental value of houses is rather low in the Clay-Hills Area due to the excessive number of empty houses caused by many families leaving the area. Also, depreciation and interest on investment was not charged against the house. Average investment in housing in the Clay Hills was about $3,000; therefore, the depreciation and interest charge was low. In general, the rental value of the house approximately equaled the interest and depreciation on the house.

[2]Does not include depreciation or interest on house investment.

[3]Does not include unpaid family labor charge.

[4]Nonfarm Income: Transfer; old age payments, aid to dependent children, blind payments, etc., and family support. Other; OASI, retirement & pensions, rentals, and leases & royalties.

[5]Net family money income: Net cash farm income plus total nonfarm work receipts plus total nonwork income.

earned from off-farm employment, \$460[4], or 19 percent, from farming, and \$132, or 5 percent, from nonwork sources. However, there were wide variations in the amounts individual families received from each of the three sources. For example, 13 families received an average nonwork income of \$588, while the remaining 45 families received none. Over two-fifths (43 percent) of the families received less than \$250 net money income from the farm operation;[5] in fact, one-third of the families actually lost money on their farming endeavors. In these instances, income earned from off-farm work was used to subsidize the farming operation. Yearly depreciation of farm buildings and farm machinery averaged \$207 and interest on investment (not including dwelling) averaged \$353 for a total of \$560 non cash expenses per farm. On the other hand, farm perquisites averaged only \$386.

If one looks only at the net money incomes this group received from farming, the plight of the group appears rather dismal. However, when non-money incomes are considered, the picture is brightened somewhat. For the small farmer, the value of farm perquisites is an important component of farm income. For half the farmers in this group, the value of such perquisites exceeded net cash farm income. When this value is added to the money income from farming, the net returns from the farm operation were positive for nine farmers out of ten. It appears that many of the part-time farmers are producing primarily for home consumption in an effort to realize some return on past investments in land and machinery.

### Levels of Income and Farm Characteristics

There appears to be a positive association between acres of cropland available and net money income from farming (Table 5). In the part-time farm operation, however, the size of the farm enterprise is more likely to be limited by the available labor supply than is true for other farm classes: This condition results because as the cropland acreage per part-time family increases, farm labor requirements increase. Consequently, unless there is sizable underemployment of the family labor supply, competition for family labor develops between farm and off-farm employment. From the data, it seems that a farm enterprise utilizing between 30 and 70 acres of cropland per family combined with off-farm employment will yield the highest net family money income.

Although these farms constituted only a small percentage of all part-time farms, all livestock and cash grain farms and four of the eight mixed type farms in the sample had negative cash farm incomes. However, when farm income is combined with nonfarm income, a different picture is produced. Usually, those farmers who had negative cash farm incomes had higher total net family money incomes than most farmers having positive cash farm incomes. This indicates that these operators may have adjusted their farming operations to provide the necessary time for off-farm employment, and that they were attempting to maximize total family income rather

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[4] Cash receipts minus cash expenses.

[5] Cash farm sales plus government farm payments, income from custom work, and perquisites minus cash expense, depreciations, and interest on investment. See Table 4.

**Table 5. Average net family money income, by specified farm characteristics, 58 part-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Specified farm characteristic | Families | Average net family money income: Total | Farm[1] | Nonfarm work | Nonwork |
|---|---|---|---|---|---|
| | Number | Dollars | | | |
| Total | 58 | 2,435 | 460 | 1,843 | 132 |
| Type of farm | | | | | |
| Cotton | 41 | 2,236 | 628 | 1,461 | 147 |
| Mixed | 8 | 2,742 | 340 | 2,370 | 32 |
| Cash grain | 6 | 3,109 | —12 | 2,906 | 215 |
| Livestock | 3 | 2,971 | —585 | 3,533 | 23 |
| Size of farm (Cropland acres) | | | | | |
| 1 to 19.9 | 29 | 2,092 | 88 | 1,888 | 116 |
| 20 to 29.9 | 18 | 2,536 | 652 | 1,720 | 164 |
| 30 to 69.9 | 8 | 3,268 | 1233 | 1,870 | 165 |
| 70 and over | 3 | 2,929 | 846 | 2,083 | — |
| Type of farm power used | | | | | |
| Tractor | 21 | 2,649 | 564 | 2,013 | 72 |
| Workstock | 21 | 2,242 | 216 | 1,802 | 224 |
| Workstock and tractor | 13 | 2,474 | 768 | 1,601 | 105 |
| No workstock or tractor | 3 | 2,113 | 90 | 2,000 | 23 |
| Tenure | | | | | |
| Owner-operator | 34 | 2,789 | 464 | 2,196 | 129 |
| Tenant-operator | 14 | 1,538 | 645 | 817 | 76 |
| Owner-operator rent in | 6 | 1,966 | 484 | 1,482 | — |
| Owner-operator rent out | 4 | 3.264 | —264 | 2,982 | 546 |

[1] Cash farm receipts minus cash farm expenses.

than income from the farm. For example, while all six cash grain farmers had negative cash farm incomes, four of the six had net family money incomes of more than $3,000. In contrast, only one in ten cotton farmers had negative farm incomes, but only one in five had net family money incomes of $3,000 or more.

Over three-fourths of the part-time farmers owned their farms (Table 5), and three in five neither rented in nor rented out land. The owner-operators and the owner-operator-landlords (farm operators who also rented out agricultural land) received on the average the highest net family money income of all operators in the sample and the lowest farm income. On the average, tenant operators had the highest farm income ($645) but a much lower net family money income ($1,538). This can be explained partly by the higher educational level of the two owner-operator groups. Two in three of the owner operators had had 8 or more years of schooling, whereas one in three tenants had had 8 years of schooling.

Slightly over a third of the part-time farms in the Clay-Hills had workstock as their only source of farm power. On the average, these families had a cash farm income of only $216, indicating a rather low level of farm mechanization. The operators who used tractors or tractors and workstock as their source of farm power had the highest net cash farm incomes and the highest net family money incomes of all part-time farmers.[6] Operators of mechanized part-time farms had often purchased the equipment with income from off-farm work.

### Levels of Income by Family Characteristics

The amount a family can earn from off-farm work depends, to a large extent, upon the type of family;[7] that is, on the age and sex of the household head and employability of other family members. Families of Type I, that is, those with the male heads under 45 with no occupational handicap, made up 40 percent of the families (Table 6). Almost half of these received net family money incomes of over $3,000. Type II families, which are similar to Type I families except that the head is older (45 to 64 years of age), was the largest family type and accounted for 53 percent of all families in the sample. Earnings of this group averaged lower—only one-fifth earned more than $3,000, and none earned as much as $5,000. Money incomes of Type II families are concentrated between $1,000 and $3,000 (71 percent); they averaged $2,221.

Type III families comprised only a small part of the families (7 percent) because they included only households without an employable male 18 to 64 years of age. Two of these operators were classified as craftsmen; one was a laborer, the other a propretor. The proprietor was a female household head under 65 years of age, while the other three operators were 65 years of age or older. The average net family money income received by these families was almost a third more than the average of all part-time farmers, but no meaningful generalizations can be drawn from these data because of the small number of families involved.

Apparently the age of the head of the household affects the amount of farm income received. The younger farm operators tended to have lower farm incomes than older operators. For instance, 30 percent of the operators under 45 years of age, but only 14 percent of the operators 45 years of age and older had negative net cash farm incomes. Conversely, only 13 percent of the younger operators received $1,000 or more net cash farm incomes compared with 23 percent of the older group. In contrast, income from off-farm work was generally higher for operators under 45 years of age; the percentage of total income earned from off-farm work was also higher for this group. One exception to this was when the family head was 65 years of age and older; income from off-farm work of these families was more than $2,400. The reason for this relatively high off-farm income was that one of the three heads of households who was 65 years of age and older was a craftsman (house-painter) earning $4,000 a year.

The average household head had received 8 years of formal education. In general, the heads with more years of formal schooling received higher incomes than did those with little or no education.

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[6] Net cash farm incomes does not make an allowance for depreciation charges on machinery and equipment. If depreciation is charged, farm income for the different groups would remain in the same relative relationship. That is, operators using tractors and mules would have earned $459, those using tractors only, $247, those using mules only, $158, and those without farm power, $62.

[7] See footnote 1, Table 2, for definition of Family Types.

**Table 6. Average net family money income, by specified family characteristics, 58 part-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Specified family characteristic | Families | Average family net money income | | | |
|---|---|---|---|---|---|
| | | Total | Farm[3] | Nonfarm work | Nonwork |
| | Number | - - - - - - - | - - | Dollars - - - - | - - - - - |
| Total | 58 | 2,435 | 460 | 1,843 | 132 |
| Type of family[1] | | | | | |
| I | 23 | 2,594 | 309 | 2,209 | 76 |
| II | 31 | 2,221 | 603 | 1,540 | 78 |
| III | 4 | 3,180 | 213 | 2,095 | 872 |
| Size of family | | | | | |
| 2 | 11 | 2,355 | 662 | 1,620 | 73 |
| 3 | 14 | 2,806 | 330 | 2,080 | 396 |
| 4 | 14 | 1,997 | 397 | 1,549 | 51 |
| 5 and over | 19 | 2,529 | 484 | 2,014 | 31 |
| Age of family head | | | | | |
| Under 35 | 8 | 2,411 | 120 | 2,177 | 114 |
| 35 to 44 | 15 | 2,737 | 352 | 2,313 | 72 |
| 45 to 54 | 16 | 2,148 | 566 | 1,554 | 28 |
| 55 to 64 | 16 | 2,238 | 667 | 1,411 | 160 |
| 65 and over | 3 | 3,558 | 226 | 2,447 | 885 |
| Education of family head | | | | | |
| Under 4 | 7 | 1,289 | 520 | 726 | 43 |
| 5 to 8 | 28 | 2,324 | 715 | 1,500 | 109 |
| 9 to 11 | 11 | 3,101 | 206 | 2,589 | 306 |
| 12 and over | 12 | 2,748 | 60 | 2,612 | 76 |
| Degree of labor utilization[2] | | | | | |
| Under 40 percent | 7 | 1,094 | 378 | 579 | 137 |
| 40 to 79 percent | 25 | 2,036 | 630 | 1,337 | 69 |
| 80 to 99 percent | 19 | 3,268 | 242 | 2,778 | 248 |
| 100 percent and over | 7 | 2,935 | 520 | 2,379 | 36 |

[1] See footnote 1, Table 2 for definition of Family Types.

[2] Based on estimated hours of labor performed in relation to the total number of hours an able-bodied male between 18 and 64 years of age could perform per year (exclusive of Sundays and holidays, 3,120 hours). Fewer hours per year allowed for handicapped persons, those under 18 or over 65 years of age, and females. (see, Crecink, John C., "Incomes, Resources, and Adjustment Potential of Rural Families in the Clay-Hills Area of Mississippi," AEc. M.R. No. 29, Mississippi Agricultural Experiment Station, November 1960, for details on estimating the family labor supply.)

[3] See footnote 1, Table 5.

As the educational level of the head increased, a greater proportion of the income tended to be earned from off-farm work. The younger operators who had more education devoted less of their time to the farm enterprise and more to off-farm work.

### Farm and Off-Farm Labor Utilization

In general, the available labor of part-time farm families in the Clay-Hills was not used efficiently. The average family had three household members 14 years of age and older who were available for work and had almost 5,000 hours of labor available for work annually. However, it is the extent or degree to which this available labor is utilized that affects net money income rather than the supply available. For instance, 86 percent of the families who utilized less than 60 percent of their labor had net family money incomes of less than $2,000. In contrast, 87 percent of the families who utilized 80 percent or more of their labor had net money incomes of $2,000 or more (Table 6). Five of the 58 families in the study received net family money incomes of $4,000 or more, and four of the five utilized 80 percent or more of their labor. On the average, part-time farm families utilized more than 70 percent of their available labor.

Part-time farmers received, on the average, $0.61 per hour of work (Table 7). This rate was considerably more than the $0.40 earned per hour of work by full-time farmers. However, it was much less than the hourly earnings of the full-time nonfarm workers ($1.07 per hour).

The returns per hour of work for part-time farm families include earnings from both farm and nonfarm work. Breaking the $0.61 average rate into component parts shows that income from farm work averaged only $0.17 per hour of work, even when value of perquisites is included in income, whereas income from off-farm work averaged about six times greater, $1.02 per hour. Average hourly earnings of part-time farmers from farm work were about two-fifths as great as the earnings of full-time farmers. This indicates that, in general, part-time farmers were less efficient in operating their farms than were full-time farmers. If full-time nonfarm work had been available, most part-time farm families could have increased their incomes by working full-time off the farm. Many of these families were aware of this. They would make the transition to full-time nonfarm work if such opportunities were available.

### Off-Farm Employment of Part-Time Farmers

Part-time farmers—Where do they come from? What are their backgrounds, their job experiences, and their expectations?

Constructing occupational histories for family heads from the time they were last in school or were last considered unpaid family laborers shows that family heads followed three general occupational routes: (1) school to full-time farm to part-time farm; (2) school to part-time farm; and (3) school to off-farm to part-time farm. Fifty-seven percent of the family heads were full-time farmers before becoming part-time farmers, whereas only 21 percent were previously employed full-time off the farm. The other 22 percent became part-time farmers directly upon leaving school. It seems that for younger farmers, part-time farming is the first step out of agriculture toward full-time nonfarm employment, and for older farmers toward retirement.

The type or kind of off-farm employment engaged in by part-time farmers varied. Half of the part-time farmers were classified as laborers or service workers (Table 8); 14 percent as craftsmen; and 12 percent as managers, officials, or proprietors. Other types of jobs were clerical, sales, service, professional, and technical.

Part-time farmers who worked off the farm as laborers had average net family money incomes of $1,857, almost $600 less than the average income for all part-time farm families. On the other hand, most of those in jobs that required

**Table 7. Income comparisons, 58 part-time farmers, 106 full-time farmers, and 109 off-farm employed families, Clay-Hills Area of Mississippi, 1958.**

| Item | Unit | Source of income<br>Part-time farmers | Full-time farmers | Nonfarm employed families |
|---|---|---|---|---|
| Families | No. | 58 | 106 | 109 |
| Total hours employed: | Hr. | 3,501 | 2,622 | 2,702 |
| Off-farm employment | do. | 1,812 | 30 | 2,614 |
| Farm employment | do. | 1,689 | 2,592 | 88 |
| Farm investment | Dol. | 7,064 | 7,887 | 2,846 |
| Net earned money income: | Dol. | 2,303 | 1,273 | 2,909 |
| Off-farm employment | do. | 1,843 | 6 | 2,913 |
| Farm employment[1] | do. | 460 | 1,267 | —4 |
| Value of farm product[2] | do. | 386 | 413 | 128 |
| Farm earnings[3] | do. | 846 | 1,680 | 124 |
| Interest on investment | Dol. | 353 | 394 | 142 |
| Depreciation charge | do. | 207 | 246 | 4 |
| Total | do. | 560 | 640 | 146 |
| Net farm earnings[4] | Dol. | 286 | 1,040 | —22 |
| Average returns per hour employed:[5] | Dol. | .608 | .399 | 1.070 |
| Off-farm | do. | 1.017 | .200 | 1.114 |
| Farm | do. | .169 | .401 | —.250 |

[1] Cash receipts minus cash expenses.
[2] House rental not included.
[3] Farm employment plus value of farm products consumed in home.
[4] Farm earnings minus interest on investment minus depreciation.
[5] Off-farm earnings plus net farm earnings divided by total hours employed.

**Table 8. Number of family heads, by type of off-farm employment, and average net family money income, 58 part-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Item | Laborer and service | Craftsman and professional | Total |
|---|---|---|---|
| Operators (number) | 29 | 29 | 58 |
| Average net family money income (dollars) | 1,857 | 3,012 | 2,435 |

greater skill, such as craftsmen, professionals, technicians, clerks and salesmen, had an average net family money income of slightly over $3,000, or almost $1,200 more than that of the part-time farmers employed as laborers.

Part-time farmers in the Clay-Hills had little specialized (formal) training for either farm or nonfarm work. Only one in six of the family heads had received such training. College and on-the-job training constituted the major sources (Table 9). However, only three operators had had college training, and two of these received most of their income from farming. About 9 percent of the part-time farmers had received on-the-job training.

**Table 9. Number, average net family money income, and percentage distribution of families by income levels, by specified characteristics, 58 part-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Specified characteristic | Families | Average net family money income | Distribution of families by levels of net money income: Under $1,000 | $1,000 to $1,999 | $2,000 to $2,999 | $3,000 & over |
|---|---|---|---|---|---|---|
| | Number | Dollars | - - - - - - - | Percent | - - - - - - - | |
| Total | 58 | 2.435 | 11 | 29 | 29 | 31 |
| Where specialized training was received | | | | | | |
| College | 3 | 2.331 | — | — | 33 | 67 |
| On job training | 5 | 2,707 | 20 | 20 | 20 | 40 |
| None | 50 | 2.414 | 10 | 34 | 30 | 26 |
| Source of information about present job | | | | | | |
| Applied | 9 | 3,143 | 12 | 12 | 38 | 38 |
| Family connections | 3 | 3,494 | — | — | — | 100 |
| Friend | 12 | 2.726 | — | 9 | 45 | 46 |
| Asked by employer | 3 | 2,929 | — | — | 67 | 33 |
| Other or no response | 31 | 1,966 | 15 | 46 | 21 | 18 |
| Expectations if employment were terminated | | | | | | |
| Look for another job | 18 | 3,019 | 6 | 11 | 33 | 50 |
| Start farming full-time | 19 | 2,417 | 5 | 21 | 48 | 26 |
| Undecided | 21 | 1,949 | 19 | 52 | 10 | 19 |
| Members of family 14 years old and over available for work[1] | | | | | | |
| 2 | 27 | 2,475 | 11 | 22 | 26 | 41 |
| 3 | 17 | 2,277 | 12 | 29 | 41 | 18 |
| 4 | 11 | 2,669 | 9 | 36 | 18 | 37 |
| 5 and over | 3 | 2,103 | — | 67 | 33 | — |

[1] Includes husband and wife where appropriate.

Information concerning job opportunities came from a variety of sources. Twenty-one percent of the family heads learned of their present jobs through friends; 16 percent applied for jobs without prior knowledge that a job was available; 5 percent got jobs through family connection; and 5 percent were approached by the employer. The remaining 53 percent of the family heads, however, did not remember how they learned of their present jobs.

Approximately a third of the household heads were undecided as to their course of action in the event their present jobs were terminated. However, another third said they would look for other nonfarm jobs and the remaining third said they probably would start farming full-time. Few of those who said they would look for another job would estimate the earnings necessary to persuade them to do full-time nonfarm work. Also, these operators expressed little preference for any particular type of job, thus indicating little specialized training. Many indicated that off-farm employment of any kind would be unacceptable if it meant leaving the farm. In other words, these operators intended to remain in agriculture if at all possible. For the most part, they were in the older age groups and were content to stay on their farms with their present incomes because the farm served as security in case their off-farm jobs were terminated. Also, these operators look on the farm as a place for retirement. However, even if they wanted to leave the farm, the possibility for adjustment would be remote because of their age and limited education.

### Changes in Farming

Nearly 60 percent of the operators had lived on their present farms 10 years or more, and 94 percent of these were owners. Only one in ten of the operators had lived on their present farms less than 3 years; they were primarily tenants (Table 10).

**Table 10. Method of obtaining farm land and number of years on place as an operator, 58 part-time farms, Clay-Hills Area of Mississippi, 1958.**

| Item | Farms | |
|---|---|---|
| | Number | Percent |
| Total | 58 | 100 |
| Method of obtaining land | | |
| Inheritance | 3 | 5 |
| Purchased | | |
| Cash | 15 | 26 |
| Credit | 23 | 40 |
| Rented | 14 | 24 |
| No report | 3 | 5 |
| Years farmed on place | | |
| Under 3 | 66 | 10 |
| 3 to 4 | 6 | 10 |
| 5 to 6 | 8 | 14 |
| 7 to 9 | 4 | 7 |
| 10 and over | 34 | 59 |

Approximately three-fourths of the part-time farms were owner-operated; farm ownership was acquired primarily through purchase. Forty percent of the farms were financed through mortgages and 26 percent through cash payment; only about 5 percent of the farms were obtained through inheritance. The remaining 24 percent of the farms were tenant operated.

Twenty-eight percent of the part-time farmers said they had increased the number of acres operated since 1945, whereas only 17 percent reported they had decreased the size of their operation (Table 11). More than half of the operators reported that they had made no changes in farm size.

Even though the average part-time farm was relatively small, operators generally were satisfied with the present size of their farm operations. Three-fourths indicated that their farms were about the right size; about one in five considered their farms too small, and only one in twenty thought their farms were too large.

Only one in four of the operators wanted to make any changes in their farm operations. Half of the operators who wanted to make changes wished to increase the size of their livestock enterprises. None wanted to plant addtional acreages of cash crops. The greatest single obstacle to those wanting to make changes was lack of funds. Advanced age and the fear of debt were other obstacles.

### Farm Production and Efficiency

One means of evaluating the relative efficiency of any one group is to compare its attributes with those of another group. For example, by comparing the crop and livestock production, and receipts and expenses per acre and per farm of part-time farmers with those of full-time farmers[8] in the same area, some insight can be gained into the farmers' relative efficiency in farming.

**Table 11. Size of farm: change since 1945 and adequacy, 58 part-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Item | Families | |
|---|---|---|
| | Number | Percent |
| Total | 58 | 100 |
| Changes in farm size: | | |
| No changes made | 32 | 55 |
| Increased acreage less than 25 percent | 8 | 14 |
| Increased acreage 25 to 100 percent | 3 | 5 |
| Increased acreage by 100 percent or more | 5 | 9 |
| Decreased acreage less than 25 percent | 3 | 5 |
| Decreased acreage 25 to 50 percent | 4 | 7 |
| Decreased acreage by 50 percent or more | 3 | 5 |
| Operators considered farm size to be: | | |
| Too small | 12 | 21 |
| Too large | 1 | 2 |
| About right size | 45 | 77 |

Part-time farmers planted about the same crops as did full-time farmers but usually they planted fewer acres (Table 12). For example, the proportion of part-time farmers who planted cotton was about the same as that of full-time farmers, but part-time farmers planted about one-third fewer acres of cotton per farm than did full-time farmers. Cotton and corn were the two most common crops on both types of farms.

The average crop yield per acre was about the same for both groups. For example, the average yield of lint cotton per acre was 449 and 471 pounds for part-time and full-time farmers, respectively. Also, the two groups had the same corn yields per acre—26 bushels.

Dairying on part-time farms was on a very small scale. The average dairy herd contained 5 cows. Full-time farms contained almost twice this number (Table 12). But on the average, the beef herds on part-time farms were slightly larger than those on full-time farms. Part-time and full-time farms had small hog and poultry enterprises and produced primarily for home consumption.

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[8] Data for full-time farms may be found in Crecink, John C., "Incomes, Resources, and Adjustment Potentials of Rural Families in the Clay-Hills Area of Mississippi", Mississippi Agricultural Experiment Station, AEc. M.R. No. 29.

Based on the average value of sales per farm, dairying was the most important livestock enterprise for both part-time and full-time farms. Milk sales per part-time farm were $358 compared with $742 per full-time farm. The reason for the difference in milk sales is that the full-time dairy farms carried a larger number of cows than did the part-time dairy farms. Milk sales amounted to 21 percent of the total cash farm receipts of full-time farms but only 12 percent of the total on part-time operations.

**Table 12. Comparison of crop acreages and yields, and livestock number and sales, 58 part-time and 106 full-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Item | Unit | Average per farm | |
|---|---|---|---|
| | | Part-time farm | Full-time farm |
| Number of farms | | 58 | 106 |
| Major crops[1] | | | |
| Cotton | Acres | 7 | 10 |
| Corn | do. | 15 | 17 |
| Hay | do. | 6 | 11 |
| Crop yields[1] | | | |
| Cotton | Pounds of lint | 449 | 471 |
| Corn | Bushels | 26 | 26 |
| Livestock[1] | | | |
| Dairy cattle | Number | 5 | 9 |
| Beef cattle | do. | 17 | 14 |
| Hogs | do. | 5 | 7 |
| Chickens | do. | 41 | 33 |
| Value of livestock and livestock products sold | | | |
| Dairy cattle | Dollars | 358 | 742 |
| Beef cattle | do. | 274 | 200 |
| Hogs | do. | 116 | 132 |
| Poultry | do. | 65 | 36 |

[1] For farms reporting.

The average part-time farmer had almost 4,900 hours of labor available, slightly more than the average full-time farmer (Table 13). However, part-time farm operators uitilized 72 percent of their available labor compared with only 55 percent for full-time farmers. This can be partly explained by the dual employment of the part-time farmer.

Capital has traditionally been in short supply for most farmers in the Clay-Hills Area of Mississippi. The average investment per part-time farm, for example, was approximately $8,200. This amount is only slightly less than that per full-time farm. With the low level of investment and the relatively small acreage of cropland per farm, it is to be expected that income from farming will be relatively low.

In 1958, the average cash farm receipts from farming of part-time farmers was $1,270, or about 42 percent less than for full-time farmers (Table 14). The reason for this was the greater cotton and milk production on full-time farms.

In terms of net cash farm income, part-time farmers averaged $460 per farm, approximately only a third as much as full-time farmers. However, cash farm expenses of the part-time farmers were about nine-tenths as large as those incurred by full-time farmers. Cash farm expenses of part-time farmers were 64 percent of cash farm receipts, whereas for full-time farmers, expenses amounted to only 42 percent of cash receipts. Generally speaking, part-time farmers spent about the same relative amount on individual expense items as did the full-time farmers (Table 15). Usually, however, they received considerably smaller returns per dollar of cash farm expenses. This indicates that perhaps part-time farmers are less efficient than full-time farmers in the use of farm resources.

It is evident, other things being equal, that the size of the farm operation greatly influences net farm returns. But because of the slight contribution the farm usually makes to the net money income of part-time farmers, the relationship between farm size and family net money income in this case is not discernible. However, their farms could make a greater contribution to the incomes of part-time farmers, if these farmers could become

**Table 13. Comparison of labor, capital, and land use, 58 part-time and 106 full-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Production Factor | Unit | Average per farm<br>Part-time farm | Full-time farm |
|---|---|---|---|
| Number | | 58 | 106 |
| Labor | | | |
| Total family supply | Hours | 4,888 | 4,755 |
| Utilized off-farm | do. | 1,812 | 30 |
| Utilized on farm | do. | 1,689 | 2,592 |
| Unutilized operator & family labor | do. | 1,387 | 2,133 |
| Capital | | | |
| Land and buildings | Dollars | 4,800 | 5,100 |
| Machinery and equipment | do. | 1,500 | 1,800 |
| Livestock | do. | 700 | 1,000 |
| Nonfarm property | do. | 1,200 | 600 |
| Total owned assets | do. | 8,200 | 8,500 |
| Total debt | do. | 900 | 1,100 |
| Net worth | do. | 7,300 | 7,400 |
| Land | | | |
| Owned | Acres | 63 | 71 |
| Rented in | do. | 11 | 29 |
| Rented out | do. | 2 | 1 |
| Total land operated | do. | 72 | 99 |
| Cropland | do. | 21 | 31 |
| Woodland | do. | 28 | 36 |
| Open land | do. | 44 | 63 |

**Table 14. Comparison of farm income and expenses, 58 part-time and 106 full-time farms, Clay-Hills Area of Mississippi, 1958.**

| Farm income and expenses | Average per farm | |
|---|---|---|
| | Part-time | Full-time |
| | Dollars | |
| Cash receipts | 1,270 | 2,185 |
| Cash expenses | 810 | 918 |
| Net cash income from farm | 460 | 1,267 |
| Depreciation on machinery and equipment | 207 | 246 |
| Net family farm income[1] | 253 | 1,021 |
| Value of farm perquisites[2] | 386 | 413 |
| Net family farm earnings[3] | 639 | 1,434 |
| Nonfarm income | 1,976 | 10 |
| Net family earnings[4] | 2,615 | 1,444 |

[1] Net cash farm income minus depreciation on machinery and equipment.
[2] See footnote 1, Table 4.
[3] Net family farm income plus value of farm perquisites.
[4] Net family farm earnings plus nonfarm income.

**Table 15. Comparison of farm expense items, 58 part-time and 106 full-time farm families, Clay-Hills Area of Mississippi, 1958.**

| Farm expense items | Avg. expense per farm | | Percentage of total exp. | |
|---|---|---|---|---|
| | Part-time | Full-time | Part-time | Full-time |
| | Dollars | | Percent | |
| Fertilizer and lime | 164 | 220 | 20 | 24 |
| Labor (regular & seasonal) | 64 | 79 | 8 | 9 |
| Custom work | 9 | 15 | 1 | 2 |
| Repairs (machinery and equipment) | 133 | 93 | 16 | 10 |
| Feed supplies (including grinding) | 120 | 130 | 15 | 14 |
| Tractor fuel & oil | 45 | 95 | 5 | 10 |
| Selling cost | 31 | 67 | 4 | 7 |
| Cash rent | 4 | 9 | 1 | 1 |
| Insecticide | 12 | 22 | 2 | 2 |
| Interest | 32 | 42 | 4 | 5 |
| Insurance | 29 | 18 | 4 | 2 |
| Taxes | 59 | 27 | 7 | 3 |
| Other | 107 | 101 | 13 | 11 |
| Total | 809 | 918 | 100 | 100 |

more efficient in using the farm resources they presently control. Generally speaking, given current management and the present farm organization, the farm enterprises conducted by part-time farmers lead to inefficient operations. On the other hand, the part-time farm operation is usually limited by the amount of labor available for farm work. Therefore, the possibility of expanding the size of part-time farm units is limited.

### Part-Time Farming As a Transitional Phase

While some part-time farmers may have begun as such and will remain so throughout their productive years, most of them are in a transitional phase. That is, part-time farming is an intermediate stage in the transition of the family from full-time farm work to either full-time nonfarm work or retirement. Data from the broader study (See Crecink, John C., "Incomes, Resources, and Adjustment Potential of Rural Families in the Clay-Hills Area of Mississippi", Mississippi Agricultural Experiment Station, AEc. M.R. No. 29) relative to the occupational histories of the full-time nonfarm families indicate that slightly more than six in ten of these families had operated full-time farms at one stage in their development. Four in six of these families had used part-time farming as a transitional step from full-time farming to full-time nonfarm work.

This analysis suggests that off-farm employment will become more important to the agricultural economy of the area. Census data suggest that between 1950 and 1959 the number of part-time farms in the area increased by half; at the same time, the total number of farms decreased by a third. If industrialization of the area progresses, it could well be that in the near future, part-time farmers could become the dominant farm group. However, the composition of the group will change continuously.

Some broad implications on the increasing role that part-time farming will assume in the agricultural production of the Clay-Hills Area are: (1) a general increase in the level of net money income received by these families; (2) a decreasing dependence on farming as a source of family income; (3) even less efficiency in the use of farm resources than is now achieved; (4) the holding of proportionately more resources out of full-time farming; and (5) a possible shift of more agricultural resources into production of such commodities as beef cattle and timber, which can be produced on an extensive scale.

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# Cost Of Producing Hogs In Confinement

By BARNEY H. JACKS and
TRAVIS D. PHILLIPS

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

# PREFACE

This bulletin contains estimates of costs of producing pork on concrete. As with any other costs study, it should be realized that the cost estimates are based on average prices or prices at a particular time and place and average rates of production. Each producer must adjust the prices and rates of production to his particular conditions.

The system of production described in this bulletin consists of the more efficient systems being followed by many of the larger Mississippi producers who have been producing hogs on concrete for several years. Many of these producers began with facilities designed for seasonal farrowing but have found them inadequate for the continuous operation being practiced. The facilities described in this bulletin have been designed to fit 50-, 75-, and 100-sow continuous breeding programs.

Because of a shortage of feeder pigs it is generally necessary for the feeder to produce them. This bulletin presents the costs of producing feeder pigs as well as the costs of feeding out pigs to market weights.

It is not intended to imply that other systems of producing hogs are not efficient. The purpose of studying the system presented in this bulletin was to describe an efficient method of producing pork as a major enterprise.

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# COST OF PRODUCING HOGS IN CONFINEMENT

## By BARNEY H. JACKS and TRAVIS D. PHILLIPS

In the mid-1950's, when a rapid advance in vertical integration in agriculture seemed certain, many people felt that pork production would shift southward and follow the same general pattern as that of broilers. Some felt that the South would become the pork-producing area of the nation. The advent of the pig parlor for confinement feeding helped foster this belief.

Seeing in the combination of new techniques and high pork prices the potential for expanding the feed market, feed dealers promoted confinement feeding. Many Southern producers built pig parlors. Some were soon discouraged by sharp declines in hog prices, increases in disease problems, and the scarcity of feeder pigs. Pork, however, has been produced successfully in confinement by a few producers for many years. The more efficient continue to produce, and new producers continue to enter the field.

Vertical integration, however, has had little effect upon the hog industry in Mississippi. Many feed-mill owners operate pig parlors; some feed dealers finance producers' feed purchases until the hogs are sold; and some producers have arrangements with packers. In the main, though, the hog feeder acts as an independent.

The increase in feeding-out operations has meant an increase in the demand for feeder pigs. Since no ready supply has become available, most feeders are forced to produce their own pigs. To assure a steady flow of market hogs, producers are turning from the traditional seasonal farrowing to a continuous farrowing operation. Since large-scale production of hogs under such methods is a relatively new undertaking for Mississippi producers, they have no experience from which to draw estimates of management requirements, facilities needed, or cost expectations.

### Objectives

The purpose of this study was to describe the organization and the production methods used in the more efficient pig parlor operations in Mississippi and to estimate production costs associated with these methods. Specifically, the objectives were to estimate:

1. Costs of producing feeder pigs under a continuous farrowing program;
2. Costs of feeding hogs to market weights in concrete parlors, with continuous use of facilities; and
3. The profitability of producing hogs by these methods.

For the benefit of those interested in only one phase of production, costs estimates for producing feeder pigs and for feeding out hogs are presented separately in this report. Then, for those interested in both feeder-pig production and feeding-out operations, these costs are combined to provide estimates of total costs of producing market hogs.

### Methods of Estimating Costs

Production practices outlined in this publication are those recommended by the Animal Husbandry Department, Mississippi State University, and followed by most of the producers interviewed. Building plans are those recommended by the University's Agricultural Extension Service for seasonal farrowing. Producers are using the plans either as recommended or with modifications. A continuous farrowing system necessitates modifications in the ratio of farrowing stalls to nursing and finishing units if maximum use of the facilities is to be obtained.

Prices of equipment and feed ingredients were obtained from producers and farm supply firms (Appendix Table 1). Labor was charged at one dollar per hour. Building costs per square-foot were obtained from producers and from other studies where similar types of construction were used. (2, 3, 5).[1] Building costs include labor, fencing costs do not. Producers may be able to lower costs by constructing the facilities themselves. Land utilized by the enterprise was valued arbitrarily at $100 per acre. Value of breeding stock was placed at $50 for gilts and $75 for boars. Because of heavier weights it was assumed that the value of animals replaced would offset the costs of new animals.

Feed rations used are those recommended by the Animal Husbandry Department of the University (Appendix Tables 4 and 5). Because of the number of ingredients in the creep ration and the relatively small quantities fed per year, a commercially-prepared creep ration was considered purchased for purposes of calculating costs.

In calculating annual costs, facilities were depreciated by the straight-line method.[2] (See Appendix Table 7 for depreciation rates used.) Repairs were charged at 4 percent of the investment in buildings and equipment. Interest at 5 percent was charged on one-half of the original investment in depreciable items and on full inventory value of land and breeding stock.

To provide for differences in enterprise size and levels of efficiency in management likely to be encountered, cost estimates were made for several situations. Production costs were estimated for herds of 50, 75, and 100 sows, farrowing twice annually. Average of 7, 8, and 9 pigs per litter were considered. Finally, to show the effect that feed conversion ratio (Pounds of feed per pound of hog produced) has upon finishing hosts, feed-out costs were estimated for three levels of feed conversion.

## Producing Feeder Pigs

Few hog feeders in the South are able to purchase an ample supply of feeder pigs. If feeding operations in the area are to increase appreciably, advances must be made in feeder-pig production. This section of the report is devoted to a discussion of producing feeder pigs under continuous breeding programs.

A continuous breeding not only affords a continuous supply of pigs for sale as feeders or for feeding-out on the producer's farm, but also reduces production costs through wider use of facilities.

### Facilities and Management

In 50-sow herds, an average of two sows are farrowed each week. In herds of 75- and 100-sows, the numbers farrowing per week average three and four, respectively. Pregnant sows are brought into a central farrowing house and cleaned up about a week before farrowing. The farrowing house, equipped with 5' x 8' farrowing stalls and, generally, with a large attic fan for cooling, is normally located adjacent to the nursing area. Sows in the farrowing house are fed, watered, and exercised twice daily in a paved exercise yard, a few at a time.

When pigs are about a week old, the sow and pigs are moved to a pave nursing area. This area is divided into a series of 10' x 24' pens, with the north half of each pen shedded.

Two sows and litters share each nursing pen. Sows are hand-fed a 14% protein ration; young pigs are fed an 18% commercially-mixed creep ration in creep feeders and later switched to self-feeders.

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[1] Numbers in parentheses refer to references

[2] Annual depreciation charge for each facility was calculated by dividing the original cost by the number of years the facility is expected to last.

Lacating sows consume an average of 12 pounds of feed daily. With good management, suckling pigs will consume an average of half a pound of 18% ration daily for an average daily gain of .70 pounds. Pigs are weaned after 7 weeks at an average weight of 40 pounds.

One boar is maintained for each 25 sows. Boars and dry sows are kept on native pasture. One-sixth acre of pasture is provided for each sow, and one-fourth acre for each boar. The sow pasture is cross-fenced to facilitate the breeding program and the moving of sows into the farrowing house on schedule. In 50- and 75-sow operations electric cross-fences are so arranged that not more than 6 sows may be pastured in one paddock. In larger operations this maximum may be increased to 12. Ten square feet of shelter is provided per sow. Boars are pastured individually and housed in A-frame sheds.

Boars and dry sows are fed 6 pounds of 14% protein ration daily. Boars are hand-fed, and sows are self-fed. Automatic waterers are used for all animals.

Veterinary practices and number of inoculations vary widely among the producers interviewed. Feeder pigs are castrated, given iron shots, and, generally, vaccinated for cholera and erysipelas.

Other studies indicate that while labor requirements per sow drop sharply as sow numbers are increased to 25, reductions resulting from further increases in herd size are negligible (**1**, **4**, **5**). For that reason a 14.2-hour labor requirement was used for operations of all sizes analyzed in this study. Labor requirements per day would average 1.95 for the 50-sow enterprise, 2.92 for the 75-sow enterprise, and 3.89 for the 100-sow enterprise.

### Investment

Capital investment in land and facilities for a 50-sow enterprise amounts to $6,326 (Table 1). Investment in breeding stock brings total capital investment for an enterprise of that size to $8,976. For a 100-sow enterprise investment totals $16,382.

These investment figures are based on facility requirements and prices shown in Appendix Tables 1 and 2. They do not include investment in feed-storage facilities, since many producers do not store appreciable quantities of feed. Neither do they include the cost of a complete water

**Table 1.—Investment requirements for feeder pig production for selected size enterprises.**

| Item | Size of enterprise<br>50 sows | 75 sows | 100 sows |
|---|---|---|---|
| | — — — — — — Dollars | — — — — — — | |
| Land and Facilities: | | | |
| Land | 750 | 1,075 | 1,400 |
| Farrowing house and nursing pens | 4,038 | 5,540 | 7,043 |
| Pasture sheds | 244 | 366 | 488 |
| Boar Sheds | 90 | 136 | 181 |
| Fencing | 470 | 620 | 734 |
| Water pipe | 206 | 227 | 248 |
| Feeders | 328 | 492 | 620 |
| Waterers | 182 | 279 | 338 |
| Heat lamps | 18 | 24 | 30 |
| Total land and facilities | 6,326 | 8,759 | 11,082 |
| Breeding Stock: | | | |
| Sows | 2,500 | 3,750 | 5,000 |
| Boars | 150 | 225 | 300 |
| Total breeding stock | 2,650 | 3,975 | 5,300 |
| Total investment | 8,976 | 12,734 | 16,382 |
| Investment per pig produced[1] | 11.22 | 10.61 | 10.24 |

[1] Based upon an average production of 8 pigs per litter.

system. In most instances the farm's existing water system will provide the small additional quantities of water needed for the feeder pig enterprise. (Where a feed-out operation is added to the feeder-pig enterprise, a deep well is required.)

Economies in investment as the size of the enterprise is enlarged occur because all facilities need not be increased proportionately to the increase in sow numbers. When weanings per litter average 8 pigs, investment per pig produced annually declines from $11.22 for the 50-sow enterprise to $10.24 for enterprises of 100 sows.

### Costs

With the facilities and levels of management and costs used in this study, feeder pigs can be produced for $9.25 per head in a 50-sow enterprise if 8 pigs are saved per litter and for $9.14 per head in an enterprise twice that size (Table 2). The lower production costs in the larger enterprise result from a reduction in overhead costs per pig.

Annual operating costs (all costs except depreciation and interest on investment) total about $6,800 for a 50-sow enterprise and $13,500 for one of 100-sow size. These annual operating costs are based upon input requirements and prices shown in Appendix Tables 1 and 3. If no hired labor is used, yearly cash-outlay requirements can be reduced by about 10 percent and costs per pig by about 90 cents.

The number of pigs saved per litter has considerable effect upon the costs per

**Table 2.—Annual costs of producing feeder pigs for seelcted size enterprises, 8 pigs saved per litter.**

| Item | Size of enterprise | | |
|---|---|---|---|
| | 50 sows | 75 sows | 100 sows |
| | — — — — — — Dollars | — — — — — — | |
| Investment Costs: | | | |
| Depreciation: | | | |
| Housing | 195.52 | 271.80 | 348.62 |
| Equipment | 72.96 | 107.08 | 133.83 |
| Fencing | 23.50 | 31.03 | 36.68 |
| Water pipe | 13.72 | 15.12 | 16.52 |
| Interest on investment | 309.40 | 444.61 | 577.04 |
| Total | 615.10 | 869.64 | 1,112.69 |
| Operating Costs: | | | |
| Feed: | | | |
| Pigs — 18% protein | 1,170.00 | 1,755.00 | 2,340.00 |
| Sows — 14% protein[1] | 3,586.39 | 5,379.85 | 7,172.78 |
| Boars — 14% protein[1] | 116.62 | 175.19 | 233.24 |
| Labor | 710.00 | 1,065.00 | 1,420.00 |
| Repairs | 223.04 | 307.36 | 387.28 |
| Veterinary and medicines[2] | 852.00 | 1,278.00 | 1,704.00 |
| Electricity | 128.21 | 192.31 | 256.41 |
| Total | 6,786.26 | 10,152.71 | 13,513.71 |
| Total costs | 7,401.36 | 11,022.35 | 14,626.40 |
| Cost per pig | 9.25 | 9.19 | 9.14 |

[1] Costs include $3.00 per ton for grinding and mixing.

[2] $1.00 per head for sows, pigs, and boars.

**Table 3.—Per-head costs of producing feeder pigs for selected size enterprises and pigs saved per litter.**

| Pigs saved | Size of enterprise | | |
|---|---|---|---|
| | 50 sows | 75 sows | 100 sows |
| | — — — — — — — — — | Dollars — — — — — — — — — | |
| 7 | 10.18 | 10.11 | 10.06 |
| 8 | 9.25 | 9.19 | 9.14 |
| 9 | 8.53 | 8.47 | 8.42 |

pig. Data in Table 3 indicate declines of about $1.64 in per-head production costs as the number saved per litter is increased from 7 to 9.

## Feeding-Out Hogs

Estimates of confinement feeding costs presented in this section are based upon finishing 800, 1200, ad 1600 hogs to 200-pound weights. These numbers of hogs equal the annual output of 50-, 75-, and 100-sow feeder-pig enterprises when an average of 8 pigs are saved per litter. Finishing costs are first estimated for situations where a feed conversion ratio of 3.50 is obtained. Then, estimates of costs associated with feed ratios of 3.75 and 3.25 are presented.

### Facilities and Management

Hogs are finished in concrete-floored pens. The floor should have a slope sufficient to faciliate cleaning and to keep it dry. Approximately two-thirds of the pen is roofed for weather protection and to provide shade. Twelve square feet of floor space per hog was allowed.

Finishing pens were designed to accomodate a two-week supply of feeder pigs from the 50- and 75-sow herds, and a one-week output of the 100-sow herd. Since 40-pound pigs should reach 200-pound weights in approximately 100 days, the smaller operation requires a total of eight 12 x 32-foot feeding pens, and the larger, a total of 15. For a 75-sow operation, eight 18 x 32-foot pens are needed. With that number of pens, each pen can be refilled in 15 weeks.

Overhead bulk feed bins which permit the refilling of feeders without handling the feed are provided. Placed above the partitions, one storage bin would serve two pens. The storage bins would hold up to 4 tons of feed and would be refilled every two weeks.

The smaller pens are equipped with 8-hole feeders, the larger ones with 12-hole feeders, to provide one feed-hole for each four hogs. Double cup automatic waterers are used in all pens, one cup being provided for 16 hogs. In 1600-hog operations, costs can be reduced by placing part of the waterers in the partitions between pens.

Because of the high water-pressure requirements for washing floors, a deep well is needed for the feeding enterprise. The pump should provide at least 600 gallons per hour at a 60-pound pressure. Excess water afforded by this system may be used for other enterprises on the farm.

Most producers include in the water system a spray to provide a light mist for cooling hogs in the hot summer months.

Young feeder pigs are started on a 16-percent protein ration. When hog weights reach 125 pounds, the protein level is dropped to 12 percent. With a 3.50 feed conversion ratio, a 40-125 pound pig will consume 5.25 pounds of feed per day and 1.5 pounds per day. Hogs in the 125-200 pound weight range will consume an average of 5.95 pounds of feed per day with an average daily gain of 1.7 pounds.

Labor requirements obtained from Mississippi producers are similar to those used in a North Carolina study (**5**). Annual labor requirements were estimated to be 400, 504, and 608 hours for the 800, 1200, and 1600-hog enterprises, respectively. Labor requirements per day would average 1.10 hours for the 800-hog enterprise, 1.38 hours for the 1200-hog enterprise and 1.67 hours per day for the 1600-hog enterprise.

### Investment

When based on facility requirements and prices shown in Appendix Tables 1 and 6, investment in facilities for finishing 800 hogs annually totals slightly more than $6,000 and averages $7.52 per hog (Table 4). As the size of the enterprise is increased, investment required per head declines, primarily because the cost of the water system is spread over a larger number of hogs.

## Costs

When the cost of feeder pigs is not included, feed costs comprise about 94 percent of the total costs of finishing hogs, if a feed conversion ratio of 3.50 is obtained. Labor is the second most important item. With price levels used in this study, finishing costs average $16.18 per head when 800 hogs are finished annually (Table 5). The more intensive use of facilities and labor that results when the size of enterprise is doubled reduces per-head costs by 24 cents.

Since feed is such an important item of cost, considerable savings result from improving the feed conversion ratio. Reducing this ratio from 3.50 to 3.25 cuts costs by about $1.06 per head (Table 6). Costs are increased by about the same amount if the feed ratio increases to 3.75.

**Table 4. Investment requirements for feeding selected numbers of hogs annually.**

| Item | Number fed annually | | |
|---|---|---|---|
| | 800 | 1200 | 1600 |
| | Dollars | | |
| Land | 100 | 100 | 100 |
| Finishing pens | 3,840 | 5,760 | 7,200 |
| Feed storage bins | 400 | 600 | 800 |
| Feeders | 480 | 704 | 900 |
| Waterers | 136 | 204 | 255 |
| Water system[1] | 1,062 | 1,062 | 1,062 |
| Total | 6,018 | 8,430 | 10,317 |
| Investment per hog | 7.52 | 7.03 | 6.45 |

[1] 300 ft. of drilling and casing; pump and 120-gallon tank.

**Table 5.—Costs of finishing selected numbers of hogs to 200-pound weights with a 3.50 feed conversion ratio.**

| Item | Number fed annually | | |
|---|---|---|---|
| | 800 | 1200 | 1600 |
| | Dollars | | |
| Investment Costs: | | | |
| Depreciation: | | | |
| Housing | 153.60 | 230.40 | 288.00 |
| Equipment | 77.60 | 114.80 | 147.50 |
| Water system | 66.32 | 66.32 | 66.32 |
| Interest | 152.95 | 213.25 | 260.43 |
| Total | 450.47 | 624.77 | 762.25 |
| Operating Costs: | | | |
| Feed | 11,847.15 | 17,773.35 | 23,694.30 |
| Labor | 400.00 | 504.00 | 608.00 |
| Repairs | 236.72 | 333.20 | 408.68 |
| Electricity for pumping water | 12.96 | 19.44 | 25.92 |
| Total | 12,496.83 | 18,629.99 | 24,736.90 |
| Total costs | 12,947.30 | 19,254.76 | 25,499.15 |
| Costs per hog | 16.18 | 16.05 | 15.94 |

**Table 6.—Per-head costs of feeding hogs to 200-pound weights for selected feed convrsion ratios and numbers of hogs fed annually.**

| Feed conversion ration | Number fed annually | | |
|---|---|---|---|
| | 800 | 1200 | 1600 |
| 3.75 | 17.24 | 17.10 | 17.00 |
| 3.50 | 16.18 | 16.05 | 15.94 |
| 3.25 | 15.11 | 14.99 | 14.88 |

## Investment and Costs In Producing Marketing Hogs

An investment of about $15,000 is required for an enterprise in which 800 feeder pigs a year are produced and finished to market weights. Annual costs for this enterprise are approximately $20,000 (Table 7). On a per head basis, this amounts to an investment of $18.74 and a cost of $25.44. If the size of the enterprise is doubled, per-head investment declines by $2.05 and average cost by 36 cents. Total labor requirements per day for the feeder pig operation and the feeding operation would average 3.05 hours for the 800-hog enterprise, 4.30 hours for the 1200-hog enterprise, and 5.56 hours for the 1600-hog enterprise.

The preceding estimates are for situations where an average of 8 pigs are saved per litter and a feed conversion ratio of 3.50 is obtained in the finishing-out operation. Costs can be reduced appreciably by increasing the number of pigs saved and improving feed efficiency. Data in Table 8 indicate that costs decline by about 90 cents per hundredweight as the number of pigs saved is increased from 7 to 9, and by $1.06 per hundredweight as the feed conversion ratio drops from 3.75 to 3.25. Thus the alert pork producer can reduce production costs by approximately two dollars per hundredweight through good management. Increasing both herd size and management can reduce production costs by as much as $2.14 per hundredweight.

**Table 7. Investment and costs of producing market hogs: 8 pigs saved per litter, 3.50 feed conversion ratio, selected size enterprise.**

| Item | 50 sows 800 feeders | 75 sows 1200 feeders | 100 sows 1600 feeders |
|---|---|---|---|
| | — — — — — — | — Dollars — | — — — — — — |
| Investment: | | | |
| in feeder pig enterprise | 8,976 | 12,734 | 16,382 |
| in finishing enterprise | 6,018 | 8,430 | 10,317 |
| Total | 14,994 | 21,164 | 26,699 |
| per hog produced | 18.74 | 17.64 | 16.69 |
| Annual Costs: | | | |
| of producing feeder pigs | 7,401 | 11,022 | 14,626 |
| of finishing hogs | 12,947 | 19,255 | 25,499 |
| Total | 20,348 | 30,277 | 40,125 |
| per hog produced | 25.44 | 25.23 | 25.08 |

**Table 8.—Hundredweight costs of market hogs for selected size enterprises, numbers of pigs saved per litter, and feed efficiency.**

| Pigs | 50 sows | | | 75 sows | | | 100 sows | | |
|---|---|---|---|---|---|---|---|---|---|
| saved | Feed conversion | | | Feed conversion | | | Feed conversion | | |
| per litter | 3.75 | 3.50 | 3.25 | 3.75 | 3.50 | 3.25 | 3.75 | 3.50 | 3.25 |
| | — — — | — — — | Dollars | per | hundredweight | — | — | — | — — |
| 7 | 13.76 | 13.23 | 12.70 | 13.64 | 13.12 | 12.59 | 13.56 | 13.04 | 12.50 |
| 8 | 13.24 | 12.72 | 12.18 | 13.14 | 12.62 | 12.08 | 13.06 | 12.54 | 12.00 |
| 9 | 12.84 | 12.31 | 11.78 | 12.74 | 12.22 | 11.69 | 12.67 | 12.14 | 11.62 |

## Profitability

Prices of hogs normally reach their annual high in July or August, then drop sharply during the fall. The year's low is usually reached in late fall or early winter, after which prices rise to a secondary peak about late winter. Prices then decline briefly before a very substantial summer advance begins.

Prices are highest in mid-summer because, with most producers following a seasonal farrowing program, fewer hogs are marketing in the summer. The low winter prices are caused by pig marketing at that time.

The feeder who follows a continuous program markets essentially the same number of hogs each month in the year. By so doing he hits both the high and the low of the market or, in effect, "averages out" the market.

Over the last five years prices of No. 1 & 2 200-220-pound barrows and gilts have averaged $17.53 per hundred pounds on the Memphis market (Appendix Table 8). With prices at that level, hog production appears profitable over the long pull even for the highest-cost set-up included in this analysis (the 50-sow enterprise with 7 pigs saved per litter and a 3.75 feed conversion ratio). In only 4 months—October 1959-January 1960—of the 60-month period did prices drop below the $13.76 production cost. Even for the years that included these low-price months, the annual average prices would have resulted in sizeable average margins above production costs.

For the producer who saves 8 pigs per litter and has a 3.50 feed conversion ratio and finishes 1600 hogs annually at a cost of $12.54 per hundredweight, the margin would have averaged $4.99 per hundredweight, or approximately $10 per head, over the 5-year period. (Transportation and marketing costs would have to be deducted from that margin.) For the year 1958, Memphis prices averaged $20.69 per hundredweight, $8.05 above production costs. Sharp price declines in the fall of 1959 reduced the annual price for that year to $15.26, the lowest in the 5-year period. Yet that average would have allowed the producer with a cost of $12.54 a gross margin of $2.72 per hundred pounds. For the producer with top efficiency—9 pigs saved per litter and 3.25 feed ratio—who produces 1800 hogs annually at a cost of $11.62, margins would have averaged $9.17 per hundredweight for the high year, $3.74 for the low year, and $5.91 over the 5-year period.

## Summary

Established producers in Mississippi are producing and finishing hogs in confinement the year around. This study provides estimates of costs of producing feeder pigs and of finishing hogs to market weights when practices of such producers and recommendations of the Animal Husbandry Department of Mississippi State University are followed.

To show the effect of size of operation and level of management on costs the study includes three sets of variable conditions: Pig production costs were estimated for breeding herds of 50, 75, and 100 sows farrowing twice annually. The number of pigs saved per litter was varied from 7 to 9. Estimates of feed-out costs are based on feed conversion ratios of 3.25, 3.50, and 3.75.

Costs of producing 40-pound feeder pigs ranged from $10.18 for 7 pigs saved per litter in the 50-sow enterprise to $8.42 for 9 saved in the 100-sow operation. Costs of finishing a hog from 40 to 200 pounds ranged from $17.24 when 800 are finished annually at a feed conversion ratio of

3.75 to $14.88 when 1600 are finished at a feed ratio of 3.25.

When production cost of the feeder pig is included, costs of finishing a pig from a litter of 7 in the 50-sow enterprise average $13.76 per hundredweight when a 3.75 feed conversion ratio is obtained. Corresponding costs for a hog from a litter of 9 in the 100-sow operation with a feed conversion ratio of 3.25 average $11.62 per hundredweight.

These data emphasize the importance of management in keeping the litter size high and the feed conversion ratio low. As a result of lower feeder pig costs and larger numbers fed, hundredweight costs of producing a 200-pound hog decline by about 90 cents as the number of pigs saved increases from 7 to 9. Reducing the feed conversion ratio from 3.75 to 3.25 reduces costs by $1.06 per hundredweight. Based on the prices used in this study, increasing both herd size and management can reduce production costs by as much as $2.14 per hundredweight.

At the level of hog prices that has existed over the past five years, confinement production appears highly profitable. Where 8 pigs are saved per litter, feed conversion ratio is 3.50, and 1600 hogs are finished annually, the margin above the $12.54 production costs would have averaged $8.05 per hundredweight in 1958, the high year of the period; $2.72 in 1959, the low year; and $4.99 over the 5 years. In each of the 5 years there would have been a sizeable profit margin even for the producer whose costs averaged as high as $13.76.

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# Appendix

**Appendix Table 1.—Prices of input items Mississippi, 1960.**

| Item | Unit | Cost per unit |
|---|---|---|
| Feed ingredients (used in 12, 14 & 16% ration) | ton | |
| Ground yellow corn ( 1.25 per bu.) | | $ 44.60 |
| Soybean meal (44% protein) | | 57.80 |
| Deflourinated rock phosphate | | 65.20 |
| Ground limestone | | 11.60 |
| Trace mineralized salt | | 55.00 |
| Vitamin and antibiotic mix | | [1] |
| Creep ration | ton | 130.00 |
| Feed grinding and mixing | ton | 3.00 |
| Housing | | |
| Farrowing house and nursing pen | sq. ft. | 1.25 |
| Finishing pens | sq. ft. | 1.25 |
| Pasture shed | sq. ft | .678 |
| Boar shed, A-type, equipped | each | 45.00 |
| Heat lamps | each | 3.00 |
| Feed storage bins | | |
| 800 hogs | each | 400.00 |
| 1200 hogs | each | 600.00 |
| 1600 hogs | each | 800.00 |
| Feeders | | |
| 12-hole | each | 88.00 |
| 8-hole | each | 60.00 |
| 4-hole | each | 36.00 |
| Creep | each | 5.00 |
| Waterers, automatic | | |
| Single | each | 11.60 |
| Double | each | 17.00 |
| Deep-well water system | | |
| Drilling and 4" casing | ft. | 1.99 |
| 3/4" pipe | ft. | .21 |
| 1 H. P. pump equipped with 120-gallon water tank | each | 465.23 |
| Fencing | | |
| 3" creosote post | each | .70 |
| Barbed wire | roll | 8.50 |
| Field wire — 32-inch | roll | 18.50 |
| Galvanized wire | roll | 5.50 |
| Fence charger | each | 28.95 |
| Labor | hr. | 1.00 |
| Electricity | KWH | .03 |
| Pumping water (cost of electricity) | | |
| Shallow well | 000 gal. | .023 |
| Deep well | 000 gal. | .075 |

[1] $3.45 per ton of feed mixed.

Appendix Table 2.—Facilities required for selected size feeder-pig enterprises.

| | | Number of sows | | |
|---|---|---|---|---|
| Item | unit | 50 | 75 | 100 |
| **Land** | | | | |
| Farrowing and nursing area | ac. | 1 | 1 | 1 |
| Pasture | ac. | 6.5 | 9.75 | 13 |
| **Fencing** | | | | |
| Field wire (pasture | rod | 160 | 233 | 252 |
| Galvanized wire for cross-fencing | rod | 155 | 304 | 220 |
| Electric charger | no. | 1 | 1 | 1 |
| **Buildings and pens** | | | | |
| Farrowing house | sq. ft. | 330 | 440 | 550 |
| Farrowing stalls | no. | 6 | 8 | 10 |
| Exercise area | sq. ft. | 676 | 676 | 676 |
| Nursing sheds and pens | no. | 8 | 12 | 16 |
| Nursing sheds and pens | sq. ft. | 2104 | 3156 | 4208 |
| Sow pasture sheds: | | | | |
| 10' x 12' | no. | 3 | 4 | 6 |
| 6' x 10' | no. | 0 | 1 | 0 |
| Boar sheds, equipped 8' x 7½' | no. | 2 | 3 | 4 |
| **Equipment** | | | | |
| Feeders | | | | |
| in exercise pen (4-hole) | no. | 1 | 1 | 1 |
| in nursing pens | | | | |
| 4-hole (in half of pens) | no. | 4 | 6 | 8 |
| Creep ( 2 in half of pens) | no. | 8 | 12 | 16 |
| in sow pasture | | | | |
| 4-hole (in fence between) | no. | 3 | 5 | 6 |
| Automatic waterers | | | | |
| Single-cup | | | | |
| in exercise pen | no. | 1 | 1 | 1 |
| in sow pasture | no. | 0 | 1 | 6 |
| Double-cup | | | | |
| in nursing pens | no. | 4 | 6 | 8 |
| in sow pasture | no. | 3 | 4 | 0 |
| Water pipe (3/4" galv.) | ft. | 712 | 827 | 923 |
| Heat lamp | no. | 6 | 8 | 10 |

Appendix Table 3. Variable input requirements for selected size feeder-pig enterprises, 8 pigs saved per litter.

| | | Number of sows | | |
|---|---|---|---|---|
| Item | Unit | 50 | 75 | 100 |
| Feed | | | | |
| Pig creep — 18% protein (.50 lbs./day) | tons | 9.00 | 13.50 | 18.00 |
| Sows — 14% protein (12 lbs./day lactation; 6 lbs./day gestation and dry) | tons | 67.35 | 101.03 | 134.70 |
| Boars — 14% protein (6 lbs./day) | tons | 2.19 | 3.29 | 4.38 |
| Labor (14.2 hours per sow per year) | hours | 710 | 1065 | 1420 |
| Electricity for heating (84 KWH per sow) | KWH | 4200 | 6300 | 8400 |
| Water (120 gal./pig) | 000 gal. | 96 | 144 | 192 |

**Appendix Table 4. Creep ration, 18% protein.**

| Ingredients | Pounds |
|---|---|
| Ground yellow corn | 612 |
| Soybean meal (44% protein) | 600 |
| Dried whey | 200 |
| Dried skim milk | 100 |
| Sugar (dextrose) | 200 |
| Rolled oats or oat groats | 200 |
| Animal fat | 40 |
| Steamed bone meal or dicalcium rock phosphate | 22 |
| Ground limestone | 10[1] |
| Trace-mineralized salt[2] | 10 |
| Vitamin and antibiotic mix[3] | 6 |
| Total | 2000 |

[1] If deflourinated rock phosphate is used, ground limestone should be 6 lbs. per ton.

[2] Should contain at least 0.5% zinic.

[3] Three pounds of thet vitamin and anibiotic mix to contain Vitamin A, 1.5 million I.U.; Vitamin D, 225,000 I.U.; riboflavin, 1.5 grams; niacin, 10 grams; pantolheric acid, 6 grams; choline, 75 grams; Vitamin B12, 12 milligrams and antibiotic (or combination of antibiotics) 20 grams.

SOURCE: Animal Husbandry Department, Mississippi State University.

**Appendix Table 5. Growing and finishing rations.**

| Ingredients | 16% protein Pigs weighing 40-125 lbs. | 14% protein Breeding stock[1] | 12% protein Pigs weighing 125-200 lbs. |
|---|---|---|---|
| | (Pounds) | (Pounds) | (Pounds) |
| Ground yellow corn | 1,507 | 1,629 | 1,737 |
| Soybean meal (44% protein) | 440 | 330 | 220 |
| Steamed bone meal or dicalcium phosphate or deflourinated rock phosphate | 28 | 14 | 18 |
| Ground limestone | 12[2] | 14[3] | 12[4] |
| Trace mineralized salt[5] | 10 | 10 | 10 |
| Vitamin and antibiotic mix[6] | 3 | 3 | 3 |
| Total | 2,000 | 2,000 | 2,000 |

[1] This ration is sometimes recommended as the second ration in the feed-out operation for hogs weighing 100-150 pounds.

[2] Used with deflourinated rock phosphate at a rate of 6 lbs. ground limestone per ton.

[3] Used with deflourinated rock phosphate at a rate of 12 lbs. ground limestone per ton.

[4] Used with deflourinated rock phosphate at a rate of 8 lbs. ground limestone per ton.

[5] Should contain at least 0.5% zinc.

[6] Three pounds of the vitamin and antibiotic mix to contain vitamin A, 1.5 million I.U.; Vitamin D, 225,000 I.U.; riboflavin, 1.5 grams; niacin, 10 grams; Pantolheric acid, 6 grams; choline, 75 grams; Vitamin B12, 12 milligrams, and antibiotic (or combinatio nof antibiotics), 20 grams.

SOURCE. Animal Husbandry Department, Mississippi State University.

**Appendix Table 6. Input requirements for confinement feeding of selected numbers of hogs.**

| Item | Unit | Number of hogs<br>800 | <br>1200 | <br>1600 |
|---|---|---|---|---|
| Feeding pens (12' x 32') | no. | 8 | 0 | 15 |
| Feeding pens (18' x 32') | no. | 0 | 8 | 0 |
| Floor space in pens (12 sq. ft./hog) | sq. ft. | 3072 | 4608 | 5760 |
| Feeders (8-hole, 4 hogs/hole) | no. | 8 | 0 | 15 |
| Feeders (12-hole, 4 hogs/hole) | no. | 0 | 8 | 0 |
| Waterers (double, 16 hogs/waterer) | no. | 8 | 12 | 15 |
| Land | ac. | 1 | 1 | 1 |
| Deep well (600 GPH at 60 PSI, 1 H.P. electric motor) | no. | 1 | 1 | 1 |
| Feed[1] | | | | |
| 16% protein (40-125 lbs.: 5.25 lb./da.) | tons | 117.6 | 176.4 | 235.2 |
| 12% protein (125-200 lbs.: 5.95 lb.:/da.) | tons | 104.7 | 157.1 | 209.4 |
| Labor | | | | |
| Per hog | hrs. | .50 | .42 | .38 |
| Total | hrs. | 400 | 504 | 608 |
| Water (216 gal./hog) | 000 gal. | 17.8 | 259.2 | 345.6 |

[1] Based upon an average feed conversion ratio of 3.50.

**Appendix Table 7. Years of expected life and depreciation rates of facilities.**

| Item | Years of expected life | Annual depreciation rate |
|---|---|---|
| | (Number) | (Percent) |
| Farrowing house and nursing pens | 25 | 4 |
| Feed-out pens and feed storage bins | 25 | 4 |
| Pasture sheds | 10 | 10 |
| Fences | 20 | 5 |
| Feeders | 10 | 10 |
| Creep Feeders | 5 | 20 |
| Waterers | 10 | 10 |
| Deep-well pump and tank | 10 | 10 |
| Water pipe | 15 | 6.67 |
| Heat lamp | 1 | 100 |

Appendix Table 8.—Barrows and Gilts: Monthly and annual average prices per hundred pounds, Memphis, Tennessee, July 1956 - June 1961.

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Yr. Av. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Dollars | | | | | | | |
| | | | | | | U. S. No. 1 & 2 — 200-220 lbs. | | | | | | | |
| 1956[2] | | | | | | | 16.04 | 16.45 | 15.99 | 15.54 | 14.73 | 16.66 | 15.90[3] |
| 1957[2] | 17.80 | 16.86 | 17.06 | 17.74 | 17.81 | 19.28 | 20.43 | 20.66 | 19.10 | 17.07 | 17.05 | 18.83 | 18.31 |
| 1958[2] | 19.24 | 20.09 | 21.34 | 20.80 | 22.59 | 23.12 | 23.17 | 21.28 | 20.52 | 19.10 | 18.57 | 18.43 | 20.69 |
| 1959 | 17.52 | 16.08 | 16.25 | 16.71 | 16.88 | 16.74 | 14.58 | 15.01 | 14.08 | 13.37 | 13.30 | 12.65 | 15.26 |
| 1960 | 13.30 | 14.02 | 15.87 | 16.44 | 16.64 | 17.52 | 17.88 | 17.03 | 16.90 | 17.70 | 17.76 | 17.99 | 16.59 |
| 1961 | 17.88 | 18.56 | 17.85 | 17.48 | 17.20 | 17.41 | | | | | | | 17.73[3] |
| 5-year average | | | | | | | | | | | | | 17.53 |
| | | | | | | U. S. No. 2 & 3 — 200-220 lbs. | | | | | | | |
| 1959 | 17.15 | 15.48 | 15.57 | 15.95 | 16.24 | 16.13 | 14.00 | 14.56 | 13.61 | 12.88 | 12.81 | 12.08 | 14.70 |
| 1960 | 12.61 | 13.50 | 15.28 | 15.81 | 15.92 | 16.75 | 17.50 | 16.46 | 16.42 | 17.13 | 17.20 | 17.34 | 15.99 |
| 1961 | 17.28 | 17.97 | 17.25 | 16.89 | 16.45 | 16.79 | | | | | | | 17.10[3] |
| 2½-year average | | | | | | | | | | | | | 15.67 |

[1] Based on the mean of daily range of quotations.

[2] Prices for these years are for No. 1, 2 & 3 grades.

[3] 6-month average.

SOURCE: Forms LS-214-1, Livestock Division, Agricultural Marketing Service.

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# Normal Yields And Production Practices By Soil Mapping Units Delta Area of Mississippi

By

Thomas E. Tramel
Walter E. Keenan
Harvey B. Vanderford

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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# NORMAL YIELDS AND PRODUCTION PRACTICES BY SOIL MAPPING UNITS DELTA AREA OF MISSISSIPPI

By THOMAS E. TRAMEL, WALTER E. KEENAN, and HARVEY B. VANDERFORD

Considerable effort has been expended in soil classification which is based upon physical characteristics. This classification is in itself quite valuable in planning the organization and operation of farms. Many other uses also exist. However, the value of soil classification is enhanced considerably for farm planning purposes if normal yields and normal production practices associated with each soil classification are also available. This study was made to provide this type of information for the Delta Area of Mississippi.

Data for the study were obtained by personal interview with a sample of farmers in the Delta Area. The sample was selected in the manner indicated in Appendix A.

Generally, a relatively large number of observations is required for averages from data obtained in the manner of this study to be reliable. Results are reported in this study only for soil-crop combinations where ten or more observations were obtained.

Normal yields and normal production practices are presented in Appendix B for cotton, corn, rice, soybeans, oats, and wheat on each soil mapping unit for which ten or more observations were obtained. For some purposes, a grouping of soils into the three broad classifications of sandy, mixed, and clay may be more appropriate than the individual soil mapping units. Results for this type of grouping are also presented for the above crops and for hay. Where appropriate, and where more than ten observations were obtained, results are presented for non-irrigated and for irrigated crops.

To facilitate comparison of normal yields for the different soils, these data are presented in Tables 1-4.

### Cotton

Normal yields for non-irrigated cotton averaged higher on soil mapping unit 136, nearly level phase, than on any other soil. Yields ranged from 735 pounds of lint for this soil to 404 pounds on soil mapping unit 312, level phase (Table 1). All sandy soils averaged 669 pounds for non-irrigated cotton compared to 568 pounds and 462 pounds for mixed and clay soils, respectively.

Irrigated cotton yields averaged about the same for the different soil mapping units. The highest was 775 pounds for 446, nearly level phase, compared to 707 pounds for 456, nearly level phase, the lowest. All sandy soils averaged 728 pound of lint when irrigated compared to 658 pounds for all mixed soils.

A comparison of yields for irrigated and non-irrigated sandy soils indicates a difference of only 59 pounds in favor of irrigation. The same comparison for mixed soils indicates a difference of only 90 pounds. In both instances, however, an average of less than two irrigations were applied. In addition, the sandy and mixed classifications each include a large number of soil mapping units which are not represented equally in the broader classifications. Thus, the differences in yield should not be interpreted as increases which can be obtained from a sound irrigation program.

### Corn

Normal yields for non-irrigated corn ranged from 78 bushels per acre for soil mapping unit 136, nearly level phase, to 46 bushels for 424, nearly level phase (Table 2). For the broader classifications,

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[1] A mapping unit, which appears on soil maps, is a combination of soil type, slope or lay of the land, and the degree of erosion.

non-irrigated sandy soils averaged 74 bushels per acre compared to 61 bushels and 47 bushels for mixed and clay soils, respectively.

Irrigated corn yields averaged 83 bushels per acre for sandy soils compared to 74 bushels per acre for mixed soils. As was the case for cotton, differences in irrigated and non-irrigated yields should not be interpreted as yield increases which can be expected from a sound irrigation program.

### Rice

Normal rice yields averaged about the same for all soils on which the crop was grown. Mixed soils averaged 74 bushels per acre compared to 77 bushels on clay soils (Table 3).

### Soybeans

Soybean yields differ less, depending upon soils, than do some of the other crops. Non-irrigated normal yields ranged from a high of 28 bushels per acre for soil mapping unit 333, nearly level phase, and T825, nearly level phase, to a low of 21 bushels for 446, nearly level phase, (Table 4). For the broader soil classifications, sandy, mixed, and clay soils averaged 24, 25, and 25 bushels, respectively.

Irrigated normal yields were obtained for only two soil mapping units: 312, level phase, and 322, nearly level phase. Yields averaged 32 and 34 bushels, respectively. Irrigated sandy and mixed soils averaged 34 and 32 bushels, respectively.

**Table 1. Normal cotton yields by soil mapping units, Delta Area of Mississippi, 1960.**

| Soil mapping unit | Number of observations | Average yield, pounds of lint per acre |
|---|---|---|
| 134, nearly level phase, non-irrigated | 36 | 662 |
| 136, nearly level phase, irrigated | 10 | 772 |
| 136, nearly level phase, non-irrigated | 76 | 735 |
| 312, level phase, non-irrigated | 26 | 404 |
| 312, nearly level phase, non-irrigated | 64 | 477 |
| 322, nearly level phase, non-irrigated | 98 | 479 |
| 333, nearly level phase, non-irrigated | 24 | 576 |
| 423, nearly level phase, non-irrigated | 57 | 504 |
| 424, nearly level phase, non-irrigated | 61 | 541 |
| 425, nearly level phase, non-irrigated | 68 | 548 |
| 426, nearly level phase, non-irrigated | 29 | 608 |
| 434, nearly level phase, non-irrigated | 51 | 588 |
| 435, nearly level phase, irrigated | 17 | 708 |
| 435, nearly level phase, non-irrigated | 69 | 607 |
| 436, nearly level phase, irrigated | 12 | 755 |
| 436, nearly level phase, non-irrigated | 61 | 662 |
| 446, nearly level phase, irrigated | 14 | 775 |
| 446, nearly level phase, non-irrigated | 36 | 696 |
| 456, nearly level phase, irrigated | 16 | 707 |
| 456, nearly level phase, non-irrigated | 54 | 657 |
| 825, nearly level phase, non-irrigated | 18 | 583 |
| T825, nearly level phase, non-irrigated | 31 | 580 |
| Sandy soils,[1] irrigated | 80 | 728 |
| Sandy soils,[2] non-irrigated | 316 | 669 |
| Mixed soils,[3] irrigated | 37 | 658 |
| Mixed soils,[4] non-irrigated | 377 | 568 |
| Clay soils,[5] non-irrigated | 202 | 462 |

[1] Includes 136, 156, 435, 436, D436, 446, 456, D456, and 825.

[2] Includes 136, 156, 435, 436, D436, 446, 456, D456, 825, and T825.

[3] Includes 134, 333, 423, 424, 425, 426 and 434.

[4] Includes 134, 333, 423, 424, 425, 426 and 434.

[5] Includes 312 and 322.

### Oats

Normal oat yields ranged from an average of 59 bushels per acre for soil mapping unit 825, nearly level phase, to 52 bushels for 435, 436, and 446, nearly level phase. For the broader classifications, sandy, mixed, and clay soils averaged essentially the same: 54, 57, and 56 bushels, respectively.

### Wheat

Only small differences were noted in normal wheat yields for the different soils. Average yields ranged only from 27 to 29 bushels per acre.

### Hay

Normal hay yields averaged slightly higher on the mixed soils than for the other two groups. Mixed soils averaged 2.5 tons per acre compared to 2.1 and 1.8 tons for sandy soils, and clay soils, respectively.

**Table 2.—Normal corn yields by soil mapping units, Delta Area of Mississippi, 1960.**

| Soil mapping unit | Number of observations | Average yield, bushels per acre |
|---|---|---|
| 136, nearly level phase, non-irrigated | 36 | 78 |
| 424, nearly level phase, non-irrigated | 14 | 46 |
| 425, nearly level phase, non-irrigated | 19 | 65 |
| 435, nearly level phase, non-irrigated | 17 | 71 |
| 436, nearly level phase, non-irrigated | 25 | 71 |
| 446, nearly level phase, non-irrigated | 18 | 72 |
| 456, nearly level phase, non-irrigated | 30 | 72 |
| 825, nearly level phase, non-irrigated | 12 | 72 |
| T825, nearly level phase, non-irrigated | 13 | 63 |
| Sandy soils,[1] irrigated | 15 | 83 |
| Sandy soils,[2] non-irrigated | 131 | 74 |
| Mixed soils,[3] irrigated | 10 | 74 |
| Mixed soils,[4] non-irrigated | 91 | 61 |
| Clay soils,[5] non-irrigated | 22 | 47 |

[1] Includes 136, 435, 436, 446, 456, D456, and T825.

[2] Includes 136, 435, 436,D436, 446, 456, D456, 825, T825, and 835.

[3] Includes 134, 424, and 425.

[4] Includes 134, 333, 423, 424, 425, 426, and 434.

[5] Includes 322.

**Table 3.—Normal rice yields by soil mapping units, Delta Area of Mississippi, 1960.**

| Soil mapping unit | Number of observations | Average yield, bushels per acre |
|---|---|---|
| 312, level phase | 20 | 75 |
| 312, nearly level phase | 11 | 79 |
| 322, nearly level phase | 25 | 79 |
| Mixed soils,[1] | 20 | 74 |
| Clay soils,[2] | 64 | 77 |

[1] Includes 333, 423, 424, 425, 426, 434, and T825.

[2] Includes 212, 312, and 322.

**Table 4.—Normal soybean yields by soil mapping units, Delta Area of Mississippi, 1960.**

| Soil mapping unit | Number of observations | Average yield, bushels per acre |
|---|---|---|
| 134, nearly level phase, non-irrigated | 37 | 26 |
| 136, nearly level phase, non-irrigated | 50 | 27 |
| 312, level phase, irrigated | 10 | 32 |
| 312, level phase, non-irrigated | 29 | 24 |
| 312, nearly level phase, non-irrigated | 82 | 25 |
| 322, level phase, non-irrigated | 13 | 27 |
| 322, nearly level phase, irrigated | 13 | 34 |
| 322, nearly level phase, non-irrigated | 130 | 26 |
| 333, nearly level phase, non-irrigated | 22 | 28 |
| 423, nearly level phase, non-irrigated | 64 | 25 |
| 424, nearly level phase, non-irrigated | 74 | 25 |
| 425, nearly level phase, non-irrigated | 69 | 23 |
| 426, nearly level phase, non irrigated | 27 | 24 |
| 434, nearly level phase, non-irrigated | 55 | 26 |
| 435, nearly level phase, non-irrigated | 48 | 23 |
| 436, nearly level phase, non-irrigated | 23 | 23 |
| 446, nearly level phase, non-irrigated | 15 | 21 |
| 456, nearly level phase, non-irrigated | 28 | 22 |
| 825, nearly level phase, non-irrigated | 17 | 26 |
| T825, nearly level phase, non-irrigated | 31 | 28 |
| Sandy soils,[1] irrigated | 15 | 34 |
| Sandy soils,[2] non-irrigated | 174 | 24 |
| Mixed soils,[3] non-irrigated | 25 | 32 |
| Mixed soils,[4] non-irrigated | 398 | 25 |
| Clay soils,[5] irrigated | 33 | 33 |
| Clay soils,[6] non-irrigated | 268 | 25 |

[1] Includes 136, 435, 436, D456, and T825.

[2] Includes 135, 136, 435, 436, D436, 446, 456, D456, 825 and T825.

[3] Includes 134, 333, 423, 424, 425, and 434.

[4] Includes 134, 333, 423, 424, 425, 426, and 434.

[5] Includes 312 and 322.

[6] Includes 212, 312, 322, and 332.

**Table 5.—Normal oat yields by soil mapping units, Delta Area of Mississippi, 1960.**

| Soil mapping unit | Number of observations | Average yield, bushels per acre |
|---|---|---|
| 134, nearly level phase | 21 | 58 |
| 136, nearly level phase | 45 | 58 |
| 312, nearly level phase | 48 | 57 |
| 322, nearly level phase | 63 | 57 |
| 333, nearly level phase | 11 | 58 |
| 423, nearly level phase | 33 | 56 |
| 424, nearly level phase | 34 | 55 |
| 425, nearly level phase | 48 | 53 |
| 426, nearly level phase | 17 | 53 |
| 434, nearly level phase | 27 | 61 |
| 435, nearly level phase | 46 | 52 |
| 436, nearly level phase | 32 | 52 |
| 446, nearly level phase | 18 | 52 |
| 456, nearly level phase | 35 | 54 |
| 825, nearly level phase | 11 | 59 |
| T825, nearly level phase | 13 | 64 |
| Sandy soils,[1] | 189 | 54 |
| Mixed soils,[2] | 216 | 57 |
| Clay soils,[3] | 122 | 56 |

[1] Includes 135, 136, 435, 436, D436, 446, 456, 825, T825, and 835.
[2] Includes 134, 333, 423, 424, 425, 426, and 434.
[3] Includes 212, 312, 322, and 332.

**Table 6.—Normal wheat yields by soil mapping units Delta Area of Mississippi, 1960.**

| Soil mapping unit | Number of observations | Average yield, bushels per acre |
|---|---|---|
| 312, nearly level phase | 20 | 27 |
| 322, nearly level phase | 15 | 28 |
| 423, nearly level phase | 10 | 29 |
| 425, nearly level phase | 10 | 28 |
| Sandy soils[1] | 17 | 28 |
| Mixed soils[2] | 45 | 28 |
| Clay soils[3] | 39 | 27 |

[1] Includes 136, 435, 436, 446, 456, D456, 825, T825, and 835.
[2] Includes 134, 333, 423, 424, 425, 426, and 434.
[3] Includes 312 and 322.

**Table 7.—Normal hay yields by soil texture, Delta Area of Mississippi, 1960.**

| Soil texture | Number of observations | Average yield, tons per acre |
|---|---|---|
| Sandy soils[1] | 10 | 2.1 |
| Mixed soils[2] | 24 | 2.5 |
| Clay soils[3] | 21 | 1.8 |

[1] Includes 136, 435, and 456.
[2] Includes 134, 333, 423, 424, 425, 426, and 434.
[3] Includes 312, 322, and 332.

# APPENDIX A

The Delta Area has been completely mapped. All soils maps of the area, each covering approximately four square miles, were studied and labeled with the predominant soils mapping unit. Selection of soils mapping units for the study was then made on the basis of the number of maps labeled for each. The thirty most predominant soils mapping units were selected for study.

For each soil mapping unit selected for study, all soils maps labeled as representing predominantly soils of the particular classification were arrayed by the flight numbers appearing on the aerial photograph. From this array, study maps were selected in a systematic manner to insure "spreading" of the study maps over the entire Delta Area.

An enumerator visited each farm located on the study maps and obtained, for each soil mapping unit represented on the farm, data relative to crops grown, normal yields, and normal production practices.

# APPENDIX B

**Appendix Table 1.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 134, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 662. | 662. |
| Pound of N | 100.0 | 101. | 101. |
| Crossplowing | 36.1 | ....... | ....... |
| Subsoiling[2] | 11.1 | ....... | - |
| Other practices (times over): | | | |
| Flat breaking, fall | 11.1 | .11 | 1.00 |
| Discing, fall | 36.1 | .50 | 1.38 |
| Middle breaking, fall | 36.1 | .36 | 1.00 |
| Flat breaking, spring | 2.8 | .03 | 1.00 |
| Discing, spring | 100.0 | 2.19 | 2.19 |
| Middle breaking, spring | 97.2 | 1.53 | 1.57 |
| Harrowing | 100.0 | 1.44 | 1.44 |
| Pre-emerge | 13.9 | .14 | 1.00 |
| Hoeing | 100.0 | 3.89 | 3.89 |
| Flame cultivation | 19.4 | .47 | 2.43 |
| Post-emerge | 2.8 | .03 | 1.00 |
| Cultivation | 100.0 | 9.53 | 9.53 |
| Insecticides | 100.0 | 11.03 | 11.03 |
| Defoliation | 94.4 | .94 | 1.00 |

[1] Based on 36 observations.

[2] An average of every 2.0 years.

**Appendix Table 2.—COTTON, irrigated: Normal yield per acre and production practices, soil mapping unit 136, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 772. | 772. |
| Pounds of N | 100.0 | 111. | 111. |
| Crossplowing | 10.0 | ------ | ------ |
| Subsoiling[2] | 50.0 | ------ | ------ |
| Land forming | 30.0 | ------ | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 10.0 | .10 | 1.00 |
| Discing, fall | 20.0 | .20 | 1.00 |
| Middle breaking, fall | 20.0 | .30 | 1.50 |
| Flat breaking, spring | 10.0 | .10 | 1.00 |
| Discing, spring | 90.0 | 1.90 | 2.11 |
| Middle breaking, spring | 90.0 | 1.40 | 1.56 |
| Harrowing | 90.0 | 1.40 | 1.56 |
| Pre-emerge | 100.0 | 1.00 | 1.00 |
| Hoeing | 100.0 | 3.70 | 3.70 |
| Flame cultivation | 40.0 | 1.00 | 2.50 |
| Post-emerge | 10.0 | .10 | 1.00 |
| Cultivation | 100.0 | 10.20 | 10.20 |
| Irrigation | 100.0 | 1.90 | 1.90 |
| Insecticides | 100.0 | 13.00 | 13.00 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 10 observations.

[2] An average of every 2.6 years.

**Appendix Table 3.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 136, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 735. | 735. |
| Pounds of N | 98.7 | 102. | 103. |
| Pounds of $P_2O_5$ | 2.6 | 1. | 30. |
| Pounds of $K_2O$ | 2.6 | 1. | 37. |
| Crossplowing | 39.5 | ------ | ------ |
| Subsoiling[2] | 28.9 | ------ | ------ |
| Land forming | 3.9 | ------ | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 17.1 | .17 | 1.00 |
| Discing, fall | 31.6 | .45 | 1.42 |
| Middle breaking, fall | 27.6 | .29 | 1.05 |
| Flat breaking, spring | 2.6 | .03 | 1.00 |
| Discing, spring | 96.1 | 1.91 | 1.99 |
| Middle breaking, spring | 97.4 | 1.55 | 1.59 |
| Harrowing | 100.0 | 1.49 | 1.49 |
| Pre-emerge | 53.9 | .54 | 1.00 |
| Hoeing | 100.0 | 3.62 | 3.62 |
| Flame cultivation | 23.7 | .49 | 2.06 |
| Post-emerge | 5.3 | .05 | 1.00 |
| Cultivation | 100.0 | 9.84 | 9.84 |
| Insecticides | 100.0 | 12.34 | 12.34 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 76 observations.

[2] An average of every 2.6 years.

**Appendix Table 4.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 312, level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 404. | 404. |
| Pounds of N | 100.0 | 89. | 89. |
| Other practices (times over): | | | |
| Discing, fall | 30.8 | .35 | 1.13 |
| Middle breaking, fall | 88.5 | .88 | 1.00 |
| Discing, spring | 92.3 | 1.31 | 1.42 |
| Middle breaking, spring | 100.0 | 1.08 | 1.08 |
| Harrowing | 100.0 | 2.00 | 2.00 |
| Hoeing | 100.0 | 3.92 | 3.92 |
| Flame cultivation | 7.7 | .19 | 2.50 |
| Cultivation | 100.0 | 7.42 | 7.42 |
| Insecticides | 100.0 | 9.12 | 9.12 |
| Defoliation | 46.2 | .46 | 1.00 |

[1] Based on 26 observations.

**Appendix Table 5.—Cotton, non-irrigated: Normal yield per acre and production practices, soil mapping unit 312, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 477. | 477. |
| Pounds of N | 100.0 | 92. | 92. |
| Pounds of $P_2O_5$ | 1.6 | [3] | 20. |
| Pounds of $K_2O$ | 1.6 | [3] | 20. |
| Crossplowing | 3.1 | ---- | |
| Subsoiling[2] | 1.6 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.7 | .05 | 1.00 |
| Discing, fall | 34.4 | .38 | 1.09 |
| Middle breaking, fall | 89.1 | .91 | 1.02 |
| Discing, spring | 96.9 | 1.50 | 1.55 |
| Middle breaking, spring | 100.0 | 1.09 | 1.09 |
| Harrowing | 100.0 | 1.88 | 1.88 |
| Pre-emerge | 3.1 | .03 | 1.00 |
| Hoeing | 100.0 | 3.77 | 3.77 |
| Flame cultivation | 14.1 | .34 | 2.44 |
| Cultivation | 100.0 | 8.03 | 8.03 |
| Insecticides | 100.0 | 9.23 | 9.23 |
| Defoliation | 51.6 | .52 | 1.00 |

[1] Based on 64 observations.

[2] An average of every 3.0 years.

[3] Less than .5 pounds

**Appendix Table 6.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 322, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 479. | 479. |
| Pounds of N | 100.0 | 93. | 93. |
| Pounds of $P_2O_5$ | 1.0 | [2] | 40. |
| Pounds of $K_2O$ | 1.0 | 1. | 75. |
| Crossplowing | 6.1 | -------- | -------- |
| Land forming | 2.0 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 1.0 | .01 | 1.00 |
| Discing, fall | 45.9 | .52 | 1.13 |
| Middle breaking, fall | 88.8 | .92 | 1.03 |
| Discing, spring | 96.9 | 1.39 | 1.43 |
| Middle breaking, spring | 91.8 | 1.01 | 1.10 |
| Harrowing | 100.0 | 1.74 | 1.74 |
| Pre-emerge | 3.1 | .03 | 1.00 |
| Hoeing | 100.0 | 3.88 | 3.88 |
| Flame cultivation | 18.4 | .44 | 2.39 |
| Post-emerge | 1.0 | .01 | 1.00 |
| Cultivation | 100.0 | 8.53 | 8.53 |
| Insecticides | 99.0 | 9.85 | 9.95 |
| Defoliation | 56.1 | .56 | 1.00 |

[1] Based on 98 observations.

[2] Less than .5 pounds.

**Appendix Table 7.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 333, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 576. | 576. |
| Pounds of N | 100.0 | 100. | 100. |
| Crossplowing | 12.5 | -------- | -------- |
| Subsoiling[2] | 8.3 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.2 | .04 | 1.00 |
| Discing, fall | 33.3 | .33 | 1.00 |
| Middle breaking, fall | 100.0 | 1.00 | 1.00 |
| Discing, spring | 91.7 | 1.33 | 1.45 |
| Middle breaking, spring | 91.7 | 1.00 | 1.09 |
| Harrowing | 100.0 | 1.63 | 1.63 |
| Pre-emerge | 8.3 | .08 | 1.00 |
| Hoeing | 100.0 | 3.83 | 3.83 |
| Flame cultivation | 29.2 | .63 | 2.14 |
| Cultivation | 100.0 | 9.67 | 9.67 |
| Insecticides | 100.0 | 10.50 | 10.50 |
| Defoliation | 83.3 | .83 | 1.00 |

[1] Based on 24 observations.

[2] An average of every 2.0 years.

**Appendix Table 8.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 423, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 504. | 504. |
| Pounds of N | 100.0 | 96. | 96. |
| Pounds of $P_2O_5$ | 1.8 | 1. | 40. |
| Crossplowing | 7.0 | — | — |
| Subsoiling[2] | 5.3 | — | — |
| Land forming | 1.8 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 15.8 | .16 | 1.00 |
| Discing, fall | 54.4 | .63 | 1.16 |
| Middle breaking, fall | 89.5 | .89 | 1.00 |
| Discing, spring | 96.5 | 1.32 | 1.36 |
| Middle breaking, spring | 94.7 | 1.00 | 1.06 |
| Harrowing | 100.0 | 1.79 | 1.79 |
| Pre-emerge | 10.5 | .11 | 1.00 |
| Hoeing | 100.0 | 4.00 | 4.00 |
| Flame Cultivation | 8.8 | .30 | 3.40 |
| Post-emerge | 1.8 | .02 | 1.00 |
| Cultivation | 100.0 | 8.70 | 8.70 |
| Insecticides | 100.0 | 10.19 | 10.19 |
| Defoliation | 66.7 | .67 | 1.00 |

[1] Based on 57 observations.

[2] An average of every 2.3 years.

**Appendix Table 9.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 424, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 541. | 541. |
| Pounds of N | 100.0 | 96. | 96. |
| Pounds of $P_2O_5$ | 4.9 | 5. | 107. |
| Pounds of $K_2O$ | 4.9 | 3. | 57. |
| Crossplowing | 23.0 | — | — |
| Subsoiling[2] | 6.6 | — | — |
| Land forming | 1.6 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 18.0 | .18 | 1.00 |
| Discing, fall | 34.4 | .43 | 1.24 |
| Middle breaking, fall | 45.9 | .48 | 1.04 |
| Flat breaking, spring | 1.6 | .02 | 1.00 |
| Discing, spring | 98.4 | 1.95 | 1.98 |
| Middle breaking, spring | 93.4 | 1.33 | 1.42 |
| Harrowing | 100.0 | 1.77 | 1.77 |
| Pre-emerge | 11.5 | .11 | 1.00 |
| Hoeing | 100.0 | 3.70 | 3.70 |
| Flame cultivation | 11.5 | .26 | 2.29 |
| Cultivation | 100.0 | 8.44 | 8.44 |
| Insecticides | 100.0 | 10.23 | 10.23 |
| Defoliation | 80.3 | .80 | 1.00 |

[1] Based on 61 observations.

[2] An average of every 2.5 years.

**Appendix Table 10.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 425, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 548. | 548. |
| Pounds of N | 100.0 | 99. | 99. |
| Pounds of $P_2O_5$ | 1.5 | 1. | 60. |
| Pounds of $K_2O$ | 1.5 | 1. | 60. |
| Crossplowing | 14.7 | ------- | —— |
| Subsoiling[2] | 19.1 | ------- | —— |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.4 | .04 | 1.00 |
| Discing, fall | 11.8 | .19 | 1.63 |
| Middle breaking, fall | 14.7 | .15 | 1.00 |
| Flat breaking, spring | 5.9 | .06 | 1.00 |
| Discing, spring | 100.0 | 2.13 | 2.13 |
| Middle breaking, spring | 98.5 | 1.68 | 1.70 |
| Harrowing | 100.0 | 1.54 | 1.54 |
| Pre-emerge | 29.4 | .29 | 1.00 |
| Hoeing | 100.0 | 3.66 | 3.66 |
| Flame Cultivation | 14.7 | .31 | 2.10 |
| Cultivation | 100.0 | 9.10 | 9.10 |
| Insecticides | 100.0 | 9.97 | 9.97 |
| Defoliation | 79.4 | .79 | 1.00 |

[1] Based on 68 observations.

[2] An average of every 3.1 years.

**Appendix Table 11.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 426, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 608. | 608. |
| Pounds of N | 100.0 | 97. | 97. |
| Crossplowing | 10.3 | -------- | |
| Subsoiling[2] | 37.9 | -------- | -------- |
| Other practices (times over): | | | |
| Discing, fall | 6.9 | .07 | 1.00 |
| Middle breaking, fall | 10.3 | .10 | 1.00 |
| Flat breaking, spring | 3.4 | .03 | 1.00 |
| Discing, spring | 100.0 | 2.17 | 2.17 |
| Middle breaking, spring | 100.0 | 1.90 | 1.90 |
| Harrowing | 100.0 | 1.24 | 1.24 |
| Pre-emerge | 48.3 | .48 | 1.00 |
| Hoeing | 100.0 | 3.66 | 3.66 |
| Flame cultivation | 24.1 | .52 | 2.14 |
| Post-emerge | 10.3 | .14 | 1.33 |
| Cultivation | 100.0 | 8.86 | 8.86 |
| Insecticides | 96.6 | 9.86 | 10.21 |
| Defoliation | 75.9 | .76 | 1.00 |

[1] Based on 29 observations.

[2] An average of every 2.8 years.

**Appendix Table 12.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 434, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 588. | 588. |
| Pounds of N | 98.0 | 98. | 100. |
| Pounds of $K_2O$ | 2.0 | 1. | 50. |
| Crossplowing | 15.7 | — | — |
| Subsoiling[2] | 23.5 | — | — |
| Land forming | 9.8 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 11.8 | .12 | 1.00 |
| Discing, fall | 27.5 | .27 | 1.00 |
| Middle breaking, fall | 29.4 | .31 | 1.07 |
| Flat breaking, spring | 2.0 | .02 | 1.00 |
| Discing, spring | 100.0 | 1.98 | 1.98 |
| Middle breaking, spring | 98.0 | 1.39 | 1.42 |
| Harrowing | 100.0 | 1.71 | 1.71 |
| Pre-emerge | 19.6 | .20 | 1.00 |
| Hoeing | 100.0 | 3.75 | 3.75 |
| Flame cultivation | 17.6 | .45 | 2.56 |
| Post-emerge | 7.8 | .08 | 1.00 |
| Cultivation | 100.0 | 8.76 | 8.76 |
| Insecticides | 100.0 | 10.27 | 10.27 |
| Defoliation | 74.5 | .75 | 1.00 |

[1] Based on 51 observations.

[2] An average of every 2.2 years.

**Appendix Table 13.—COTTON, irrigated: Normal yield per acre and production practices, soil mapping unit 435, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 708. | 708. |
| Pounds of N | 100.0 | 118. | 118. |
| Crossplowing | 11.8 | ........ | .... |
| Subsoiling[2] | 88.2 | ...... | ...... |
| Land forming | 35.3 | .... | .... |
| Other practices (times over): | | | |
| Flat breaking, fall | 17.6 | .18 | 1.00 |
| Discing, fall | 5.9 | .18 | 3.00 |
| Middle breaking, fall | 11.8 | .12 | 1.00 |
| Flat breaking, spring | 5.9 | .06 | 1.00 |
| Discing, spring | 94.1 | 1.82 | 1.94 |
| Middle breaking, spring | 100.0 | 1.47 | 1.47 |
| Harrowing | 100.0 | 1.71 | 1.71 |
| Pre-emerge | 64.7 | .65 | 1.00 |
| Hoeing | 100.0 | 3.82 | 3.82 |
| Flame cultivation | 5.9 | .12 | 2.00 |
| Post-emerge | 5.9 | .06 | 1.00 |
| Cultivation | 100.0 | 10.06 | 10.06 |
| Irrigation | 100.0 | 1.94 | 1.94 |
| Insecticides | 100.0 | 12.41 | 12.41 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 17 observations.

[2] An average of every 2.3 years.

**Appendix Table 14.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 435, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 607. | 607. |
| Pounds of N | 100.0 | 101. | 101. |
| Crossplowing | 13.0 | | |
| Subsoiling[2] | 26.1 | | |
| Land forming | 1.4 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 14.5 | .14 | 1.00 |
| Discing, fall | 7.2 | .10 | 1.40 |
| Middle breaking, fall | 7.2 | .07 | 1.00 |
| Flat breaking, spring | 7.2 | .07 | 1.00 |
| Discing, spring | 98.6 | 2.09 | 2.12 |
| Middle breaking, spring | 98.6 | 1.59 | 1.62 |
| Harrowing | 100.0 | 1.51 | 1.51 |
| Pre-emerge | 37.7 | .38 | 1.00 |
| Hoeing | 100.0 | 3.65 | 3.65 |
| Flame cultivation | 11.6 | .23 | 2.00 |
| Post-emerge | 1.4 | .01 | 1.00 |
| Cultivation | 100.0 | 8.77 | 8.77 |
| Insecticides | 97.1 | 9.75 | 10.04 |
| Defoliation | 87.0 | .87 | 1.00 |

[1] Based on 69 observations.
[2] An average of every 2.6 years.

**Appendix Table 15.—COTTON, irrigated: Normal yield per acre and production practices, soil mapping unit 436, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 755. | 755. |
| Pounds of N | 100.0 | 114. | 114. |
| Subsoiling[2] | 66.7 | | |
| Land forming | 33.3 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 8.3 | .08 | 1.00 |
| Discing, fall | 8.3 | .08 | 1.00 |
| Flat breaking, spring | 8.3 | .08 | 1.00 |
| Discing, spring | 100.0 | 2.08 | 2.08 |
| Middle breaking, spring | 100.0 | 1.75 | 1.75 |
| Harrowing | 100.0 | 1.67 | 1.67 |
| Pre-emerge | 83.3 | .83 | 1.00 |
| Hoeing | 100.0 | 3.42 | 3.42 |
| Flame cultivation | 8.3 | .17 | 2.00 |
| Post-emerge | 16.7 | .17 | 1.00 |
| Cultivation | 100.0 | 9.67 | 9.67 |
| Irrigation | 100.0 | 1.83 | 1.83 |
| Insecticides | 100.0 | 12.92 | 12.92 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 12 observations.
[2] An average of every 3.1 years.

**Appendix Table 16.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 436, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 662. | 662. |
| Pounds of N | 100.0 | 104. | 104. |
| Pounds of $P_2O_5$ | 1.6 | 1. | 40. |
| Pounds of $K_2O$ | 1.6 | 1. | 40. |
| Crossplowing | 23.0 | - - - | - - - |
| Subsoiling[2] | 52.5 | - - - | - - - |
| Land forming | 4.9 | - - - | - - - |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.6 | .07 | 1.00 |
| Discing, fall | 8.2 | .08 | 1.00 |
| Middle breaking, fall | 4.9 | .05 | 1.00 |
| Flat breaking, spring | 11.5 | .11 | 1.00 |
| Discing, spring | 98.4 | 2.16 | 2.20 |
| Middle breaking, spring | 98.4 | 1.54 | 1.57 |
| Harrowing | 100.0 | 1.57 | 1.57 |
| Pre-emerge | 57.4 | .57 | 1.00 |
| Hoeing | 100.0 | 3.49 | 3.49 |
| Flame cultivation | 13.1 | .31 | 2.38 |
| Post-emerge | 8.2 | .08 | 1.00 |
| Cultivation | 100.0 | 9.13 | 9.13 |
| Insecticides | 96.7 | 10.64 | 11.00 |
| Defoliation | 91.8 | .92 | 1.00 |

[1] Based on 61 observations.

[2] An average of every 3.0 years.

**Appendix Table 17.—COTTON, irrigated: Normal yield per acre and production practices, soil Mapping unit 445, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 775. | 775. |
| Pounds of N | 100.0 | 119. | 119. |
| Crossplowing | 7.1 | - - - | - - - |
| Subsoiling[2] | 78.6 | - - - | - - - |
| Land forming | 28.6 | - - - | - - - |
| Other practices (times over): | | | |
| Flat breaking, fall | 7.1 | .07 | 1.00 |
| Flat breaking, spring | 21.4 | .21 | 1.00 |
| Discing, spring | 100.0 | 2.07 | 2.07 |
| Middle breaking, spring | 100.0 | 1.50 | 1.50 |
| Harrowing | 100.0 | 1.57 | 1.57 |
| Pre-emerge | 85.7 | .86 | 1.00 |
| Hoeing | 100.0 | 3.21 | 3.21 |
| Flame cultivation | 7.1 | .14 | 2.00 |
| Post-emerge | 7.1 | .07 | 1.00 |
| Cultivation | 100.0 | 9.79 | 9.79 |
| Irrigation | 100.0 | 1.86 | 1.86 |
| Insecticides | 100.0 | 13.14 | 13.14 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 14 observations.

[2] An average of every 2.2 years.

**Appendix Table 18.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 446, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 696. | 696. |
| Pounds of N | 100.0 | 106. | 106. |
| Pounds of $P_2O_5$ | 2.8 | 1. | 35. |
| Pounds of $K_2O$ | 2.8 | 1. | 35. |
| Crossplowing | 19.4 | ------- | ------- |
| Subsoiling[2] | 25.0 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 25.0 | .25 | 1.00 |
| Discing, fall | 11.1 | .11 | 1.00 |
| Flat breaking, spring | 13.9 | .14 | 1.00 |
| Discing, spring | 100.0 | 2.14 | 2.14 |
| Middle breaking, spring | 100.0 | 1.72 | 1.72 |
| Harrowing | 100.0 | 1.44 | 1.44 |
| Pre-emerge | 58.3 | .58 | 1.00 |
| Hoeing | 100.0 | 3.75 | 3.75 |
| Flame cultivation | 5.6 | .11 | 2.00 |
| Post-emerge | 2.8 | .03 | 1.00 |
| Cultivation | 100.0 | 9.25 | 9.25 |
| Insecticides | 100.0 | 11.28 | 11.28 |
| Defoliation | 97.2 | .97 | 1.00 |

[1] Based on 36 observations.

[2] An average of every 3.0 years.

**Appendix Table 19.—COTTON, irrigated: Normal yield per acre and production practices, soil mapping unit 456, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 707. | 707. |
| Pounds of N | 100.0 | 116. | 116. |
| Pounds of $P_2O_5$ | 6.3 | 2. | 40. |
| Pounds of $K_2O$ | 6.3 | 2. | 40. |
| Crossplowing | 25.0 | ------- | |
| Subsoiling[2] | 75.0 | ------- | |
| Land forming | 25.0 | ------- | |
| Other practices (times over): | | | |
| Middle breaking, fall | 31.3 | .31 | 1.00 |
| Discing, spring | 100.0 | 1.94 | 1.94 |
| Middle breaking, spring | 100.0 | 1.50 | 1.50 |
| Harrowing | 100.0 | 1.75 | 1.75 |
| Pre-emerge | 87.5 | .88 | 1.00 |
| Hoeing | 100.0 | 3.06 | 3.06 |
| Flame cultivation | 25.0 | .44 | 1.75 |
| Cultivation | 100.0 | 9.94 | 9.94 |
| Irrigation | 100.0 | 1.88 | 1.88 |
| Insecticides | 100.0 | 12.56 | 12.56 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 16 observations.

[2] An average of every 2.5 years.

**Appendix Table 20.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 456, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 657. | 657. |
| Pounds of N | 100.0 | 103. | 103. |
| Pounds of $P_2O_5$ | 9.3 | 3. | 37. |
| Pounds of $K_2O$ | 9.3 | 5. | 49. |
| Crossplowing | 29.6 | ------- | ------- |
| Subsoiling[2] | 33.3 | ------- | ------- |
| Land forming | 7.4 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 9.3 | .09 | 1.00 |
| Discing, fall | 5.6 | .07 | 1.33 |
| Middle breaking, fall | 11.1 | .13 | 1.17 |
| Flat breaking, spring | 5.6 | .06 | 1.00 |
| Discing, spring | 96.3 | 2.15 | 2.23 |
| Middle breaking spring | 96.3 | 1.54 | 1.60 |
| Harrowing | 100.0 | 1.56 | 1.56 |
| Pre-emerge | 48.1 | .48 | 1.00 |
| Hoeing | 100.0 | 3.57 | 3.57 |
| Flame cultivation | 24.1 | .54 | 2.23 |
| Post-emerge | 7.4 | .07 | 1.00 |
| Cultivation | 100.0 | 9.37 | 9.37 |
| Insecticides | 100.0 | 11.52 | 11.52 |
| Defoliation | 94.4 | .94 | 1.00 |

[1] Based on 54 observations.

[2] An average of every 2.7 years.

**Appendix Table 21.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit 825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 583. | 583. |
| Pounds of N | 100.0 | 101. | 101. |
| Crossplowing | 16.7 | ------- | ------- |
| Subsoiling[2] | 5.6 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.6 | .06 | 1.00 |
| Discing, fall | 22.2 | .22 | 1.00 |
| Flat breaking, spring | 16.7 | .17 | 1.00 |
| Discing, spring | 94.4 | 1.94 | 2.06 |
| Middle breaking, spring | 100.0 | 1.50 | 1.50 |
| Harrowing | 100.0 | 1.78 | 1.78 |
| Pre-emerge | 27.8 | .28 | 1.00 |
| Hoeing | 100.0 | 3.39 | 3.39 |
| Flame cultivation | 5.6 | .11 | 2.00 |
| Cultivation | 100.0 | 8.83 | 8.83 |
| Insecticides | 94.4 | 9.00 | 9.53 |
| Defoliation | 88.9 | .89 | 1.00 |

[1] Based on 18 observations.

[2] An average of every 3.0 years.

**Appendix Table 22.—COTTON, non-irrigated: Normal yield per acre and production practices, soil mapping unit T825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 580. | 580. |
| Pounds of N | 100.0 | 81. | 81. |
| Pounds of $P_2O_5$ | 6.5 | 2. | 32. |
| Pounds of $K_2O$ | 6.5 | 3. | 50. |
| Crossplowing | 22.6 | -------- | -------- |
| Subsoiling[2] | 12.9 | -------- | -------- |
| Land forming | 6.5 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.2 | .03 | 1.00 |
| Discing, fall | 16.1 | .19 | 1.20 |
| Middle breaking, fall | 9.7 | .10 | 1.00 |
| Flat breaking, spring | 12.9 | .13 | 1.00 |
| Discing, spring | 96.8 | 1.65 | 1.70 |
| Middle breaking, spring | 96.8 | 1.13 | 1.17 |
| Harrowing | 100.0 | 1.84 | 1.84 |
| Pre-emerge | 41.9 | .42 | 1.00 |
| Hoeing | 100.0 | 2.77 | 2.77 |
| Flame cultivation | 3.2 | .10 | 3.00 |
| Cultivation | 100.0 | 9.10 | 9.10 |
| Insecticides | 87.1 | 6.29 | 7.22 |
| Defoliation | 64.5 | .65 | 1.00 |

[1] Based on 31 observations.

[2] An average of every 4.0 years.

**Appendix Table 23.—COTTON, irrigated: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 728. | 728. |
| Pounds of N | 100.0 | 113. | 113. |
| Pounds of $P_2O_5$ | 5.0 | 1. | 23. |
| Pounds of $K_2O$ | 5.0 | 2. | 30. |
| Crossplowing | 12.5 | -------- | -------- |
| Subsoiling[2] | 75.0 | -------- | -------- |
| Land forming | 32.5 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 13.8 | .14 | 1.00 |
| Discing, fall | 6.3 | .09 | 1.40 |
| Middle breaking, fall | 12.5 | .14 | 1.10 |
| Flat breaking, spring | 10.0 | .10 | 1.00 |
| Discing, spring | 97.5 | 1.95 | 2.00 |
| Middle breaking, spring | 98.8 | 1.45 | 1.47 |
| Harrowing | 98.8 | 1.69 | 1.71 |
| Pre-emerge | 81.3 | .81 | 1.00 |
| Hoeing | 100.0 | 3.36 | 3.36 |
| Flame cultivation | 23.8 | .65 | 2.74 |
| Post-emerge | 7.5 | .08 | 1.00 |
| Cultivation | 100.0 | 9.74 | 9.74 |
| Irrigation | 100.0 | 1.88 | 1.88 |
| Insecticides | 100.0 | 12.51 | 12.51 |
| Defoliation | 100.0 | 1.00 | 1.00 |

[1] Based on 80 observations.

[2] An average of every 2.4 years.

**Appendix Table 24.—COTTON, non-irrigated: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 669. | 669. |
| Pounds of N | 99.7 | 103. | 103. |
| Pounds of $P_2O_5$ | 2.8 | 1. | 36. |
| Pounds of $K_2O$ | 2.8 | 1. | 44. |
| Crossplowing | 24.7 | -------- | -------- |
| Subsoiling[2] | 33.5 | -------- | -------- |
| Land forming | 3.5 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 14.2 | .14 | 1.00 |
| Discing, fall | 13.6 | .18 | 1.30 |
| Middle breaking, fall | 12.0 | .13 | 1.05 |
| Flat breaking, spring | 7.3 | .07 | 1.00 |
| Discing, spring | 97.8 | 2.07 | 2.11 |
| Middle breaking, spring | 98.1 | 1.56 | 1.59 |
| Harrowing | 100.0 | 1.53 | 1.53 |
| Pre-emerge | 50.9 | .51 | 1.00 |
| Hoeing | 100.0 | 3.59 | 3.59 |
| Flame cultivation | 16.8 | .37 | 2.21 |
| Post-emerge | 4.7 | .05 | 1.00 |
| Cultivation | 100.0 | 9.34 | 9.34 |
| Insecticides | 98.7 | 11.16 | 11.31 |
| Defoliation | 94.0 | .94 | 1.00 |

[1] Based on 316 observations.

[2] An average of every 2.8 years.

**Appendix Table 25.—COTTON, irrigated: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 658. | 658. |
| Pounds of N | 100.0 | 108. | 108. |
| Pounds of $P_2O_5$ | 5.4 | 2. | 40. |
| Pounds of $K_2O$ | 5.4 | 2. | 35. |
| Crossplowing | 18.9 | -------- | -------- |
| Subsoiling[2] | 43.2 | -------- | -------- |
| Land forming | 21.6 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 10.8 | .11 | 1.00 |
| Discing, fall | 16.2 | .24 | 1.50 |
| Middle breaking, fall | 35.1 | .41 | 1.15 |
| Flat breaking, spring | 5.4 | .05 | 1.00 |
| Discing, spring | 89.2 | 1.70 | 1.91 |
| Middle breaking, spring | 91.9 | 1.32 | 1.44 |
| Harrowing | 100.0 | 1.68 | 1.68 |
| Pre-emerge | 48.6 | .49 | 1.00 |
| Hoeing | 100.0 | 3.68 | 3.68 |
| Flame cultivation | 18.9 | .35 | 1.86 |
| Post-emerge | 10.8 | .11 | 1.00 |
| Cultivation | 100.0 | 10.46 | 10.46 |
| Irrigation | 100.0 | 1.81 | 1.81 |
| Insecticides | 100.0 | 10.97 | 10.97 |
| Defoliation | 97.3 | .97 | 1.00 |

[1] Based on 37 observations.

[2] An average of every 2.6 years.

**Appendix Table 26.—COTTON, non-irrigated: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area. 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 568. | 568. |
| Pounds of N | 99.7 | 97. | 97. |
| Pounds of $P_2O_5$ | 1.9 | 1. | 69. |
| Pounds of $K_2O$ | 1.9 | 1. | 54. |
| Crossplowing | 17.2 | ------ | -------- |
| Subsoiling[2] | 14.6 | -------- | ------- |
| Land forming | 2.4 | ------- | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 9.8 | .10 | 1.00 |
| Discing, fall | 28.4 | .34 | 1.20 |
| Middle breaking, fall | 39.3 | .40 | 1.01 |
| Flat breaking, spring | 4.0 | .04 | 1.00 |
| Discing, spring | 98.1 | 1.86 | 1.90 |
| Middle breaking, spring | 96.6 | 1.38 | 1.43 |
| Harrowing | 100.0 | 1.65 | 1.65 |
| Pre-emerge | 22.0 | .22 | 1.00 |
| Hoeing | 100.0 | 3.68 | 3.68 |
| Flame cultivation | 14.6 | .35 | 2.38 |
| Post emerge | 2.4 | .03 | 1.11 |
| Cultivation | 100.0 | 8.94 | 8.94 |
| Insecticides | 98.4 | 9.88 | 10.04 |
| Defoliation | 77.7 | .78 | 1.00 |

[1] Based on 377 observations.

[2] An average of every 2.7 years.

**Appendix Table 27.—COTTON, non-irrigated: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, pounds of lint | 100.0 | 462. | 462. |
| Pounds of N | 100.0 | 92. | 92. |
| Pounds of $P_2O_5$ | 1.0 | [3] | 30. |
| Pounds of $K_2O$ | 1.0 | [3] | 48. |
| Crossplowing | 4.5 | ------- | ------- |
| Subsoiling[2] | 1.0 | ------- | ------- |
| Land forming | 1.0 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 2.0 | .02 | 1.00 |
| Discing, fall | 40.6 | .45 | 1.11 |
| Middle breaking, fall | 88.6 | .91 | 1.03 |
| Discing, spring | 96.5 | 1.44 | 1.49 |
| Middle breaking, spring | 96.0 | 1.05 | 1.09 |
| Harrowing | 100.0 | 1.82 | 1.82 |
| Pre-emerge | 2.5 | .02 | 1.00 |
| Hoeing | 100.0 | 3.84 | 3.84 |
| Flame cultivation | 14.9 | .35 | 2.37 |
| Post-emerge | .5 | [3] | 1.00 |
| Cultivation | 100.0 | 8.22 | 8.22 |
| Insecticides | 99.5 | 9.53 | 9.58 |
| Defoliation | 53.0 | .53 | 1.00 |

[1] Based on 202 observations.

[2] An average of every 2.5 years.

[3] Less than .5 pounds.

**Appendix Table 28.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 136, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 78. | 78. |
| Pounds of N | 94.4 | 123. | 131. |
| Subsoiling[2] | 19.4 | | |
| Land forming | 2.8 | —— | —— |
| Other practices (times over): | | | |
| Flat breaking, fall | 16.7 | .17 | 1.00 |
| Discing, fall | 36.1 | .58 | 1.62 |
| Middle breaking, fall | 33.3 | .36 | 1.08 |
| Discing, spring | 97.2 | 1.97 | 2.03 |
| Middle breaking, spring | 86.1 | 1.03 | 1.19 |
| Harrowing | 100.0 | 1.50 | 1.50 |
| Pre-emerge | 16.7 | .17 | 1.00 |
| Hoeing | 44.4 | .47 | 1.06 |
| Post-emerge | 13.9 | .17 | 1.20 |
| Cultivation | 100.0 | 3.81 | 3.81 |
| Insecticides | 8.3 | .08 | 1.00 |

[1] Based on 36 observations.

[2] An average of every 2.7 years.

**Appendix Table 29.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 424, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 46. | 46. |
| Pounds of N | 92.9 | 84. | 90. |
| Land forming | 7.1 | ...... | - - |
| Other practices (times over): | | | |
| Discing, fall | 50.0 | .71 | 1.43 |
| Middle breaking, fall | 35.7 | .43 | 1.20 |
| Flat breaking, spring | 14.3 | .14 | 1.00 |
| Discing, spring | 100.0 | 1.86 | 1.86 |
| Middle breaking, spring | 78.6 | .86 | 1.09 |
| Harrowing | 92.9 | 1.86 | 2.00 |
| Pre-emerge | 7.1 | .07 | 1.00 |
| Hoeing | 42.9 | .43 | 1.00 |
| Cultivation | 100.0 | 3.93 | 3.93 |

[1] Based on 14 observations.

**Appendix Table 30.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 425, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 65. | 65. |
| Pounds of N | 100.0 | 105. | 105. |
| Subsoiling[2] | 21.1 | ...... | — |
| Other practices (times over): | | | |
| Discing, fall | 5.3 | .05 | 1.00 |
| Middle breaking, fall | 10.5 | .11 | 1.00 |
| Flat breaking, spring | 5.3 | .05 | 1.00 |
| Discing, spring | 100.0 | 2.16 | 2.16 |
| Middle breaking, spring | 100.0 | 1.26 | 1.26 |
| Harrowing | 100.0 | 1.74 | 1.74 |
| Hoeing | 15.8 | .21 | 1.33 |
| Post-emerge | 15.8 | .16 | 1.00 |
| Cultivation | 100.0 | 3.74 | 3.74 |

[1] Based on 19 observations.

[2] An average of every 3.2 years.

**Appendix Table 31.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 435, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 71. | 71. |
| Pounds of N | 100.0 | 118. | 118. |
| Subsoiling[2] | 17.6 | ----- | -- |
| Land forming | 5.9 | ------ | ----- |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.9 | .06 | 1.00 |
| Discing, fall | 5.9 | .12 | 2.00 |
| Middle breaking, fall | 11.8 | .12 | 1.00 |
| Flat breaking, spring | 5.9 | .06 | 1.00 |
| Discing, spring | 94.1 | 2.18 | 2.31 |
| Middle breaking, spring | 94.1 | .94 | 1.00 |
| Harrowing | 100.0 | 1.53 | 1.53 |
| Hoeing | 35.3 | .35 | 1.00 |
| Post-emerge | 23.5 | .24 | 1.00 |
| Cultivation | 100.0 | 3.35 | 3.35 |

[1] Based on 17 observations.

[2] An average of every 2.7 years.

**Appendix Table 32.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 436, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 71. | 71. |
| Pounds of N | 100.0 | 129. | 129. |
| Subsoiling[2] | 52.0 | ------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.0 | .04 | 1.00 |
| Discing, fall | 16.0 | .20 | 1.25 |
| Flat breaking, spring | 16.0 | .16 | 1.00 |
| Discing, spring | 100.0 | 2.36 | 2.36 |
| Middle breaking, spring | 100.0 | 1.20 | 1.20 |
| Harrowing | 100.0 | 1.44 | 1.44 |
| Pre-emerge | 4.0 | .04 | 1.00 |
| Hoeing | 40.0 | .44 | 1.10 |
| Post-emerge | 16.0 | .16 | 1.00 |
| Cultivation | 100.0 | 3.56 | 3.56 |
| Insecticides | 8.0 | .08 | 1.00 |

[1] Based on 25 observations.

[2] An average of every 3.2 years.

**Appendix Table 33.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 446, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 72. | 72. |
| Pounds of N | 100.0 | 122. | 122. |
| Subsoiling[2] | 33.3 | ---- | -- |
| Other practices (times over): | | | |
| Flat breaking, fall | 16.7 | .17 | 1.00 |
| Discing, fall | 11.1 | .11 | 1.00 |
| Flat breaking, spring | 16.7 | .17 | 1.00 |
| Discing, spring | 100.0 | 2.28 | 2.28 |
| Middle breaking, spring | 100.0 | 1.11 | 1.11 |
| Harrowing | 100.0 | 1.39 | 1.39 |
| Pre-emerge | 5.6 | .06 | 1.00 |
| Hoeing | 33.3 | .33 | 1.00 |
| Post-emerge | 22.2 | .22 | 1.00 |
| Cultivation | 100.0 | 3.94 | 3.94 |

[1] Based on 18 observations.

[2] An average of every 2.8 years.

**Appendix Table 34.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 456, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 72. | 72. |
| Pounds of N | 100.0 | 116. | 116. |
| Subsoiling[2] | 20.0 | | - - |
| Land forming | 3.3 | ---- | ---- |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.7 | .07 | 1.00 |
| Discing, fall | 3.3 | .07 | 2.00 |
| Middle breaking, fall | 20.0 | .20 | 1.00 |
| Flat breaking, spring | 6.7 | .07 | 1.00 |
| Discing, spring | 96.7 | 2.30 | 2.38 |
| Middle breaking, spring | 96.7 | 1.23 | 1.28 |
| Harrowing | 100.0 | 1.67 | 1.67 |
| Hoeing | 46.7 | .47 | 1.00 |
| Post-emerge | 16.7 | .17 | 1.00 |
| Cultivation | 100.0 | 3.97 | 3.97 |

[1] Based on 30 observations.

[2] An average of every 2.2 years.

**Appendix Table 35.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit 825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 72. | 72. |
| Pounds of N | 100.0 | 121. | 121. |
| Other practices (times over): | | | |
| Discing, fall | 25.0 | .25 | 1.00 |
| Flat breaking, spring | 8.3 | .08 | 1.00 |
| Discing, spring | 100.0 | 2.17 | 2.17 |
| Middle breaking, spring | 100.0 | 1.17 | 1.17 |
| Harrowing | 100.0 | 1.83 | 1.83 |
| Cultivation | 100.0 | 4.08 | 4.08 |
| Insecticides | 8.3 | .08 | 1.00 |

[1] Based on 12 observations.

**Appendix Table 36.—CORN, non-irrigated: Normal yield per acre and production practices, soil mapping unit T825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 63. | 63. |
| Pounds of N | 100.0 | 106. | 106. |
| Other practices (times over): | | | |
| Discing, fall | 15.4 | .23 | 1.50 |
| Middle breaking, fall | 7.7 | .08 | 1.00 |
| Flat breaking, spring | 7.7 | .08 | 1.00 |
| Discing, spring | 92.3 | 1.69 | 1.83 |
| Middle breaking, spring | 100.0 | 1.08 | 1.08 |
| Harrowing | 100.0 | 1.92 | 1.92 |
| Hoeing | 46.2 | .62 | 1.33 |
| Cultivation | 100.0 | 3.46 | 3.46 |

[1] Based on 13 observations.

**Appendix Table 37.—CORN, irrigated: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 83. | 83. |
| Pounds of N | 100.0 | 135. | 135. |
| Subsoiling[2] | 86.7 | ---- | ---- |
| Land forming | 26.7 | ---- | ---- |
| Other practices (times over): | | | |
| Discing, fall | 13.3 | .13 | 1.00 |
| Middle breaking, fall | 6.7 | .13 | 2.00 |
| Discing, spring | 93.3 | 1.80 | 1.93 |
| Middle breaking, spring | 80.0 | 1.20 | 1.50 |
| Harrowing | 93.3 | 1.60 | 1.71 |
| Pre-emerge | 20.0 | .20 | 1.00 |
| Hoeing | 46.7 | .47 | 1.00 |
| Post-emerge | 33.3 | .33 | 1.00 |
| Cultivation | 100.0 | 3.47 | 3.47 |
| Irrigation | 100.0 | 1.33 | 1.33 |
| Insecticides | 20.0 | .20 | 1.00 |

[1] Based on 15 observations.

[2] An average of every 2.7 years.

**Appendix Table 38.—CORN, non-irrigated: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 74. | 74. |
| Pounds of N | 98.5 | 121. | 123. |
| Subsoiling[2] | 28.2 | ---- | ---- |
| Land forming | 2.3 | ---- | ---- |
| Other practices (times over): | | | |
| Flat breaking, fall | 9.9 | .10 | 1.00 |
| Discing, fall | 16.0 | .24 | 1.52 |
| Middle breaking, fall | 16.8 | .18 | 1.05 |
| Flat breaking, spring | 8.4 | .08 | 1.00 |
| Discing, spring | 97.7 | 2.19 | 2.24 |
| Middle breaking, spring | 94.7 | 1.11 | 1.18 |
| Harrowing | 100.0 | 1.52 | 1.52 |
| Pre-emerge | 6.9 | .07 | 1.00 |
| Hoeing | 41.2 | .43 | 1.04 |
| Post-emerge | 16.8 | .18 | 1.05 |
| Cultivation | 100.0 | 3.76 | 3.76 |
| Insecticides | 4.6 | .05 | 1.00 |

[1] Based on 131 observations.

[2] An average of every 2.8 years.

**Appendix Table 39.—CORN, irrigated: Normal yield per acre and production practices, mxied soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 74. | 74. |
| Pounds of N | 100.0 | 121. | 121. |
| Subsoiling[2] | 20.0 | ---- | ------ |
| Land forming | 30.0 | ---- | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 20.0 | .20 | 1.00 |
| Discing, fall | 10.0 | .20 | 2.00 |
| Middle breaking, fall | 10.0 | .10 | 1.00 |
| Flat breaking, spring | 20.0 | .20 | 1.00 |
| Discing, spring | 90.0 | 2.30 | 2.56 |
| Middle breaking, spring | 90.0 | 1.00 | 1.11 |
| Harrowing | 100.0 | 1.50 | 1.50 |
| Pre-emerge | 30.0 | .30 | 1.00 |
| Hoeing | 20.0 | .20 | 1.00 |
| Post-emerge | 10.0 | .10 | 1.00 |
| Cultivation | 100.0 | 3.20 | 3.20 |
| Insecticides | 10.0 | .10 | 1.00 |

[1] Based on 10 observations.

[2] An average of every 2.0 years.

**Appendix Table 40.—CORN, non-irrigated: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 61. | 61. |
| Pounds of N | 95.6 | 102. | 106. |
| Subsoiling[2] | 8.8 | ------ | ---- |
| Land forming | 1.1 | ----- | --- |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.4 | .04 | 1.00 |
| Discing, fall | 26.4 | .34 | 1.29 |
| Middle breaking, fall | 22.0 | .23 | 1.05 |
| Flat breaking, spring | 6.6 | .07 | 1.00 |
| Discing, spring | 97.8 | 1.93 | 1.98 |
| Middle breaking, spring | 92.3 | 1.11 | 1.20 |
| Harrowing | 98.9 | 1.74 | 1.76 |
| Pre-emerge | 2.2 | .02 | 1.00 |
| Hoeing | 28.6 | .34 | 1.19 |
| Post-emerge | 9.9 | .11 | 1.11 |
| Cultivation | 100.0 | 3.68 | 3.68 |
| Insecticides | 4.4 | .05 | 1.25 |

[1] Based on 91 observations.

[2] An average of every 2.8 years.

**Appendix Table 41.—CORN, non-irrigated: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 47. | 47. |
| Pounds of N | 86.4 | 91. | 106. |
| Land forming | 4.5 | -- | |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.5 | .05 | 1.00 |
| Discing, fall | 13.6 | .18 | 1.33 |
| Middle breaking, fall | 68.2 | .68 | 1.00 |
| Discing, spring | 86.4 | 1.41 | 1.63 |
| Middle breaking, spring | 95.5 | 1.05 | 1.10 |
| Harrowing | 100.0 | 1.95 | 1.95 |
| Pre-emerge | 4.5 | .05 | 1.00 |
| Hoeing | 63.6 | .64 | 1.00 |
| Post-emerge | 9.1 | .09 | 1.00 |
| Cultivation | 100.0 | 4.14 | 4.14 |

[1] Based on 22 observations.

**Appendix Table 42.—RICE: Normal yield per acre and production practices, soil mapping unit 312, level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 75. | 75. |
| Pounds of N | 25.0 | 12. | 47. |
| Other practices (times over): | | | |
| Discing, fall | 45.0 | 1.65 | 3.67 |
| Discing, spring | 70.0 | 2.00 | 2.86 |
| Harrowing | 95.0 | 2.05 | 2.16 |
| Post-emerge | 90.0 | .95 | 1.06 |
| Insecticides | 40.0 | .40 | 1.00 |

[1] Based on 20 observations.

**Appendix Table 43.—RICE: Normal yield per acre and production practices, soil mapping unit 312, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 79. | 79. |
| Pounds of N | 36.4 | 21. | 59. |
| Land forming | 9.1 | - | - |
| Other practices (times over): | | | |
| Flat breaking, fall | 36.4 | .36 | 1.00 |
| Discing, fall | 63.6 | 1.55 | 2.43 |
| Discing, spring | 90.9 | 2.45 | 2.70 |
| Harrowing | 90.9 | 1.91 | 2.10 |
| Post-emerge | 100.0 | 1.00 | 1.00 |
| Insecticides | 72.7 | .73 | 1.00 |

[1] Based on 11 observations.

**Appendix Table 44.—RICE: Normal yield per acre and production practices, soil mapping unit 322, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 79. | 79. |
| Pounds of N | 40.0 | 24. | 60. |
| Pounds of $P_2O_5$ | 4.0 | 1. | 30. |
| Land forming | 8.0 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 16.0 | .20 | 1.25 |
| Discing, fall | 52.0 | 1.84 | 3.54 |
| Discing, spring | 80.0 | 1.68 | 2.10 |
| Harrowing | 92.0 | 1.68 | 1.83 |
| Post-emerge | 88.0 | .92 | 1.05 |
| Insecticides | 24.0 | .24 | 1.00 |

[1] Based on 25 observations.

**Appendix Table 45.—RICE: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 74. | 74. |
| Pounds of N | 50.0 | 32. | 64. |
| Subsoiling[2] | 15.0 | | — |
| Land forming | 15.0 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.0 | .05 | 1.00 |
| Discing, fall | 45.0 | 1.55 | 3.44 |
| Flat breaking, spring | 5.0 | .05 | 1.00 |
| Discing, spring | 85.0 | 2.40 | 2.82 |
| Harrowing | 100.0 | 1.90 | 1.90 |
| Post-emerge | 85.0 | .85 | 1.00 |
| Insecticides | 25.0 | .25 | 1.00 |

[1] Based on 20 observations.

[2] An average of every 3.0 years.

**Appendix Table 46.—RICE: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 77. | 77. |
| Pounds of N | 32.8 | 19. | 58. |
| Pounds of $P_2O_5$ | 1.6 | [2] | 30. |
| Land forming | 7.8 | — | |
| Other practices (times over): | | | |
| Flat breaking, fall | 14.1 | .16 | 1.11 |
| Discing, fall | 48.4 | 1.58 | 3.26 |
| Discing, spring | 81.3 | 2.13 | 2.62 |
| Harrowing | 92.2 | 1.84 | 2.00 |
| Post-emerge | 92.2 | .95 | 1.03 |
| Insecticides | 42.2 | .42 | 1.00 |

[1] Based on 64 observations.

[2] Less than .5 pounds.

**Appendix Table 47.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 134, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 26. | 26. |
| Subsoiling[2] | 5.4 | --- | --- |
| Other practices (times over): | | | |
| Flat breaking, fall | 13.5 | .14 | 1.00 |
| Discing, fall | 35.1 | .41 | 1.15 |
| Middle breaking, fall | 35.1 | .35 | 1.00 |
| Discing, spring | 100.0 | 1.89 | 1.89 |
| Middle breaking, spring | 94.6 | .97 | 1.03 |
| Harrowing | 100.0 | 1.46 | 1.46 |
| Hoeing | 78.4 | .81 | 1.03 |
| Cultivation | 100.0 | 5.24 | 5.24 |

[1] Based on 37 observations.

[2] An average of every 3.5 years.

**Appendix Table 48.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 136, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 27. | 27. |
| Subsoiling[2] | 24.0 | --- | --- |
| Land forming | 6.0 | --- | --- |
| Other practices (times over): | | | |
| Flat breaking, fall | 12.0 | .12 | 1.00 |
| Discing, fall | 38.0 | .52 | 1.37 |
| Middle breaking, fall | 32.0 | .34 | 1.06 |
| Flat breaking, spring | 2.0 | .02 | 1.00 |
| Discing, spring | 94.0 | 1.86 | 1.98 |
| Middle breaking, spring | 88.0 | 1.06 | 1.20 |
| Harrowing | 98.0 | 1.36 | 1.39 |
| Pre-emerge | 18.0 | .18 | 1.00 |
| Hoeing | 68.0 | .68 | 1.00 |
| Flame cultivation | 2.0 | .02 | 1.00 |
| Cultivation | 94.0 | 5.24 | 5.57 |

[1] Based on 50 observations.

[2] An average of every 2.8 years.

**Appendix Table 49.—SOYBEANS, irrigated: Normal yield per acre and production practices, soil mapping unit 312, level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 32. | 32. |
| Practices (times over): | | | |
| Discing, fall | 70.0 | 1.20 | 1.71 |
| Middle breaking, fall | 80.0 | .80 | 1.00 |
| Discing, spring | 100.0 | 1.20 | 1.20 |
| Middle breaking, spring | 90.0 | .90 | 1.00 |
| Harrowing | 100.0 | 2.10 | 2.10 |
| Hoeing | 70.0 | .70 | 1.00 |
| Cultivation | 100.0 | 4.10 | 4.10 |
| Irrigation | 100.0 | 1.60 | 1.60 |

[1] Based on 10 observations.

**Appendix Table 50.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 312, level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 24. | 24. |
| Pounds of N | 3.4 | 3. | 100. |
| Other practices (times over): | | | |
| Discing, fall | 31.0 | .34 | 1.11 |
| Middle breaking, fall | 93.1 | .93 | 1.00 |
| Discing, spring | 93.1 | 1.17 | 1.26 |
| Middle breaking, spring | 96.6 | 1.03 | 1.07 |
| Harrowing | 100.0 | 1.90 | 1.90 |
| Hoeing | 55.2 | .66 | 1.19 |
| Cultivation | 100.0 | 4.93 | 4.93 |

[1] Based on 29 observations.

**Appendix Table 51.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 312, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 25. | 25. |
| Pounds of N | 1.2 | 1. | 45. |
| Land forming | 2.4 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.1 | .06 | 1.00 |
| Discing, fall | 32.9 | .39 | 1.19 |
| Middle breaking, fall | 89.0 | .90 | 1.01 |
| Discing, spring | 97.6 | 1.40 | 1.44 |
| Middle breaking, spring | 93.9 | .96 | 1.03 |
| Harrowing | 100.0 | 1.87 | 1.87 |
| Pre-emerge | 1.2 | .01 | 1.00 |
| Hoeing | 63.4 | .63 | 1.00 |
| Post-emerge | 1.2 | .01 | 1.00 |
| Cultivation | 97.6 | 4.48 | 4.59 |

[1] Based on 82 observations.

**Appendix Table 52.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 322, level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 27. | 27. |
| Practices (times over): | | | |
| Discing, fall | 61.5 | .69 | 1.13 |
| Middle breaking, fall | 92.3 | .92 | 1.00 |
| Discing, spring | 100.0 | 1.54 | 1.54 |
| Middle breaking, spring | 92.3 | 1.00 | 1.08 |
| Harrowing | 100.0 | 1.62 | 1.62 |
| Hoeing | 76.9 | .77 | 1.00 |
| Cultivation | 100.0 | 5.38 | 5.38 |

[1] Based on 13 observations.

**Appendix Table 53.—SOYBEANS, irrigated: Normal yield per acre and production practices, soil mapping unit 322, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 34. | 34. |
| Land forming | 7.7 | ----- | ----- |
| Other practices (times over): | | | |
| Flat breaking, fall | 23.1 | .31 | 1.33 |
| Discing, fall | 53.8 | .85 | 1.57 |
| Middle breaking, fall | 69.2 | .77 | 1.11 |
| Discing, spring | 84.6 | 1.38 | 1.64 |
| Middle breaking, spring | 69.2 | .69 | 1.00 |
| Harrowing | 100.0 | 1.85 | 1.85 |
| Hoeing | 76.9 | .77 | 1.00 |
| Cultivation | 100.0 | 4.54 | 4.54 |
| Irrigation | 100.0 | 1.31 | 1.31 |

[1] Based on 13 observations.

**Appendix Table 54.—SOYBEANS, non-irrigated: Normal yield per acre and produciton practices, soil mapping unit 322, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 26. | 26. |
| Subsoiling[2] | 1.5 | ------- | ------- |
| Land Forming | 2.3 | ----- | ----- |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.1 | .03 | 1.00 |
| Discing, fall | 39.2 | .45 | 1.14 |
| Middle breaking, fall | 80.0 | .80 | 1.00 |
| Flat breaking, spring | .8 | .01 | 1.00 |
| Discing, spring | 95.4 | 1.42 | 1.49 |
| Middle breaking, spring | 86.9 | .89 | 1.03 |
| Harrowing | 99.2 | 1.64 | 1.65 |
| Pre-emerge | .8 | .01 | 1.00 |
| Hoeing | 74.6 | .76 | 1.02 |
| Cultivation | 96.2 | 4.84 | 5.03 |

[1] Based on 130 observations.

[2] An average of every 2.0 years.

**Appendix Table 55.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 333, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 28. | 28. |
| Subsoiling[2] | 4.5 | ----- | ----- |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.5 | .05 | 1.00 |
| Discing, fall | 31.8 | .32 | 1.00 |
| Middle breaking, fall | 86.4 | .91 | 1.05 |
| Flat breaking, spring | 4.5 | .05 | 1.00 |
| Discing, spring | 95.5 | 1.55 | 1.62 |
| Middle breaking, spring | 68.2 | .68 | 1.00 |
| Harrowing | 100.0 | 1.50 | 1.50 |
| Pre-emerge | 4.5 | .05 | 1.00 |
| Hoeing | 68.2 | .73 | 1.07 |
| Cultivation | 100.0 | 5.14 | 5.14 |

[1] Based on 22 observations.

[2] An average of every 3.0 years.

**Appendix Table 56.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 423, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 25. | 25. |
| Subsoiling[2] | 4.7 | -------- | -------- |
| Land forming | 1.6 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.3 | .06 | 1.00 |
| Discing, fall | 48.4 | .48 | 1.00 |
| Middle breaking, fall | 87.5 | .88 | 1.00 |
| Discing, spring | 96.9 | 1.27 | 1.31 |
| Middle breaking, spring | 90.6 | .92 | 1.02 |
| Harrowing | 100.0 | 1.69 | 1.69 |
| Hoeing | 65.6 | .67 | 1.02 |
| Cultivation | 100.0 | 5.53 | 5.53 |

[1] Based on 64 observations.

[2] An average of every 2.7 years.

**Appendix Table 57.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 424, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 25. | 25. |
| Subsoiling[2] | 5.4 | -------- | -------- |
| Land forming | 1.4 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 2.7 | .03 | 1.00 |
| Discing, fall | 29.7 | .36 | 1.23 |
| Middle breaking, fall | 41.9 | .43 | 1.03 |
| Flat breaking, spring | 2.7 | .03 | 1.00 |
| Discing, spring | 98.6 | 1.82 | 1.85 |
| Middle breaking, spring | 82.4 | .88 | 1.07 |
| Harrowing | 100.0 | 1.65 | 1.65 |
| Hoeing | 70.3 | .70 | 1.00 |
| Cultivation | 97.3 | 4.74 | 4.88 |

[1] Based on 74 observations.

[2] An average of every 2.5 years.

**Appendix Table 58.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 425, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 23. | 23. |
| Subsoiling[2] | 15.9 | -------- | -------- |
| Land forming | 1.4 | -------- | -------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.8 | .06 | 1.00 |
| Discing, fall | 5.8 | .09 | 1.50 |
| Middle breaking, fall | 8.7 | .09 | 1.00 |
| Flat breaking, spring | 2.9 | .03 | 1.00 |
| Discing, spring | 100.0 | 1.93 | 1.93 |
| Middle breaking, spring | 89.9 | .94 | 1.05 |
| Harrowing | 100.0 | 1.59 | 1.59 |
| Pre-emerge | 4.3 | .04 | 1.00 |
| Hoeing | 66.7 | .67 | 1.00 |
| Cultivation | 98.6 | 4.93 | 5.00 |

[1] Based on 69 observations.

[2] An average of every 3.1 years.

Appendix Table 59.—SOYBEANS, non-irrigated Normal yield per acre and production practices, soil mapping unit 426, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 24. | 24. |
| Subsoiling[2] | 40.7 | ------- | ------- |
| Other practices (times over): | | | |
| Discing, fall | 11.1 | .11 | 1.00 |
| Middle breaking, fall | 7.4 | .07 | 1.00 |
| Flat breaking, spring | 3.7 | .04 | 1.00 |
| Discing, spring | 100.0 | 1.96 | 1.96 |
| Middle breaking, spring | 96.3 | 1.04 | 1.08 |
| Harrowing | 100.0 | 1.33 | 1.33 |
| Pre-emerge | 14.8 | .15 | 1.00 |
| Hoeing | 70.4 | .70 | 1.00 |
| Cultivation | 100.0 | 5.19 | 5.19 |

[1] Based on 27 observations.

[2] An average of every 2.8 years.

Appendix Table 60.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 434, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 26. | 26. |
| Subsoiling[2] | 10.9 | ------- | ------- |
| Land forming | 9.1 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.5 | .05 | 1.00 |
| Discing, fall | 27.3 | .33 | 1.20 |
| Middle breaking, fall | 30.9 | .33 | 1.06 |
| Flat breaking, spring, | 1.8 | .02 | 1.00 |
| Discing, spring | 100.0 | 1.80 | 1.80 |
| Middle breaking, spring | 90.9 | 1.09 | 1.20 |
| Harrowing | 100.0 | 1.49 | 1.49 |
| Pre-emerge | 5.5 | .05 | 1.00 |
| Hoeing | 70.9 | .73 | 1.03 |
| Post-emerge | 1.8 | .02 | 1.00 |
| Cultivation | 98.2 | 5.07 | 5.17 |

[1] Based on 55 observations.

[2] An average of every 2.7 years.

Appendix Table 61.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 435, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 23. | 23. |
| Subsoiling[2] | 16.7 | ------- | ------- |
| Land forming | 2.1 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 10.4 | .10 | 1.00 |
| Discing, fall | 10.4 | .13 | 1.20 |
| Middle breaking, fall | 6.3 | .06 | 1.00 |
| Flat breaking, spring | 6.3 | .06 | 1.00 |
| Discing, spring | 95.8 | 1.85 | 1.93 |
| Middle breaking, spring | 87.5 | .98 | 1.12 |
| Harrowing | 100.0 | 1.65 | 1.65 |
| Pre-emerge | 2.1 | .02 | 1.00 |
| Hoeing | 52.1 | .52 | 1.00 |
| Cutivation | 100.0 | 4.65 | 4.65 |

[1] Based on 48 observations.

[2] An average of every 2.8 years.

**Appendix Table 62.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 436, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 23. | 23. |
| Subsoiling[2] | 34.8 | ------ | ------ |
| Other practices (times over): | | | |
| Discing, fall | 8.7 | .09 | 1.00 |
| Middle breaking, fall | 4.3 | .04 | 1.00 |
| Flat breaking, spring | 13.0 | .13 | 1.00 |
| Discing, spring | 100.0 | 2.04 | 2.04 |
| Middle breaking, spring | 82.6 | .91 | 1.11 |
| Harrowing | 100.0 | 1.35 | 1.35 |
| Pre-emerge | 8.7 | .09 | 1.00 |
| Hoeing | 60.9 | .65 | 1.07 |
| Cultivation | 100.0 | 5.13 | 5.13 |

[1] Based on 23 observations.

[2] An average of every 3.2 years.

**Appendix Table 63.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 446, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 21. | 21. |
| Subsoiling[2] | 6.7 | ------ | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 53.3 | .53 | 1.00 |
| Flat breaking, spring | 20.0 | .20 | 1.00 |
| Discing, spring | 100.0 | 2.00 | 2.00 |
| Middle breaking, spring | 100.0 | 1.20 | 1.20 |
| Harrowing | 100.0 | 1.47 | 1.47 |
| Hoeing | 66.7 | .67 | 1.00 |
| Cultivation | 100.0 | 5.80 | 5.80 |

[1] Based on 15 observations.

[2] An average of every 3.0 years.

**Appendix Table 64.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 456, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 22. | 22. |
| Subsoiling[2] | 32.1 | ------ | ------ |
| Land forming | 7.1 | ------ | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.6 | .04 | 1.00 |
| Discing, fall | 3.6 | .04 | 1.00 |
| Middle breaking, fall | 10.7 | .11 | 1.00 |
| Flat breaking, spring | 10.7 | .11 | 1.00 |
| Discing, spring | 92.9 | 1.89 | 2.04 |
| Middle breaking, spring | 78.6 | 1.00 | 1.27 |
| Harrowing | 100.0 | 1.50 | 1.50 |
| Pre-emerge | 7.1 | .07 | 1.00 |
| Hoeing | 60.7 | .71 | 1.18 |
| Cultivation | 100.0 | 4.75 | 4.75 |

[1] Based on 28 observations.

[2] An average of every 2.9 years.

**Appendix Table 65.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, soil mapping unit 825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 26. | 26. |
| Subsoiling[2] | 11.8 | - - | - -- |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.9 | .06 | 1.00 |
| Discing, fall | 11.8 | .12 | 1.00 |
| Discing, spring | 94.1 | 1.88 | 2.00 |
| Middle breaking, spring | 76.5 | .76 | 1.00 |
| Harrowing | 100.0 | 1.53 | 1.53 |
| Pre-emerge | 5.9 | .06 | 1.00 |
| Hoeing | 64.7 | .65 | 1.00 |
| Cultivation | 76.5 | 3.65 | 4.77 |

[1] Based on 17 observations.

[2] An average of every 5.0 years.

**Appendix Table 66.—SOYBEANS, non irrigated: Normal yield per acre and production practices, soil mapping unit T825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 28. | 28. |
| Land forming | 3.2 | ... | . . |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.2 | .03 | 1.00 |
| Discing, fall | 16.1 | .23 | 1.40 |
| Middle breaking, fall | 9.7 | .10 | 1.00 |
| Flat breaking, spring | 9.7 | .10 | 1.00 |
| Discing, spring | 96.8 | 1.74 | 1.80 |
| Middle breaking, spring | 96.8 | 1.03 | 1.07 |
| Harrowing | 100.0 | 1.74 | 1.74 |
| Pre-emerge | 3.2 | .03 | 1.00 |
| Hoeing | 54.8 | .65 | 1.18 |
| Cultivation | 100.0 | 5.16 | 5.16 |

[1] Based on 31 observations.

**Appendix Table 67.—SOYBEANS, irrigated: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 34. | 34. |
| Subsoiling[2] | 73.3 | — | - ---- |
| Land forming | 33.3 | | . |
| Other practices (times over): | | | |
| Discing, fall | 13.3 | .20 | 1.50 |
| Middle breaking, fall | 13.3 | .20 | 1.50 |
| Discing, spring | 93.3 | 1.73 | 1.86 |
| Middle breaking, spring | 80.0 | .87 | 1.08 |
| Harrowing | 100.0 | 1.67 | 1.67 |
| Pre-emerge | 13.3 | .13 | 1.00 |
| Hoeing | 73.3 | .73 | 1.00 |
| Cultivation | 100.0 | 5.27 | 5.27 |
| Irrigation | 100.0 | 1.27 | 1.27 |

[1] Based on 15 observations.

[2] An average of every 2.6 years.

**Appendix Table 68.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 24. | 24. |
| Subsoiling[2] | 23.0 | -------- | -------- |
| Land forming | 3.4 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 12.1 | .12 | 1.00 |
| Discing, fall | 15.5 | .21 | 1.33 |
| Middle breaking, fall | 14.4 | .15 | 1.04 |
| Flat breaking, spring | 7.5 | .07 | 1.00 |
| Discing, spring | 96.0 | 1.90 | 1.98 |
| Middle breaking, spring | 86.8 | 1.01 | 1.17 |
| Harrowing | 99.4 | 1.51 | 1.51 |
| Pre-emerge | 8.6 | .09 | 1.00 |
| Hoeing | 59.8 | .63 | 1.05 |
| Cultivation | 97.7 | 4.98 | 5.10 |

[1] Based on 174 observations.

[2] An average of every 2.8 years.

**Appendix Table 69.—SOYBEANS, irrigated: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 32. | 32. |
| Subsoiling[2] | 28.0 | -------- | -------- |
| Land forming | 24.0 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 16.0 | .16 | 1.00 |
| Discing, fall | 32.0 | .44 | 1.38 |
| Middle breaking, fall | 44.0 | .44 | 1.00 |
| Flat breaking, spring | 4.0 | .04 | 1.00 |
| Discing, spring | 96.0 | 1.76 | 1.83 |
| Middle breaking, spring | 84.0 | .96 | 1.14 |
| Harrowing | 100.0 | 1.92 | 1.92 |
| Hoeing | 68.0 | .84 | 1.24 |
| Cultivation | 100.0 | 4.88 | 4.88 |
| Irrigation | 100.0 | 1.40 | 1.40 |

[1] Based on 25 observations.

[2] An average of every 2.4 years.

**Appendix Table 70.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 25. | 25. |
| Subsoiling[2] | 10.1 | -------- | -------- |
| Land forming | 2.3 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 5.3 | .05 | 1.00 |
| Discing, fall | 25.6 | .29 | 1.14 |
| Middle breaking, fall | 37.2 | .38 | 1.02 |
| Flat breaking, spring | 2.5 | .03 | 1.00 |
| Discing, spring | 98.5 | 1.75 | 1.77 |
| Middle breaking, spring | 88.4 | .94 | 1.07 |
| Harrowing | 100.0 | 1.58 | 1.58 |
| Pre-emerge | 3.3 | .03 | 1.00 |
| Hoeing | 68.1 | .70 | 1.03 |
| Cultivation | 98.0 | 5.03 | 5.13 |

[1] Based on 398 observations.

[2] An average of every 3.0 years.

**Appendix Table 71.—SOYBEANS, irrigated: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 33. | 33. |
| Subsoiling[2] | 3.0 | ------- | ------- |
| Land forming | 6.1 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 12.1 | .15 | 1.25 |
| Discing, fall | 54.5 | .82 | 1.50 |
| Middle breaking, fall | 72.7 | .76 | 1.04 |
| Discing, spring | 93.9 | 1.52 | 1.61 |
| Middle breaking, spring | 81.8 | .82 | 1.00 |
| Harrowing | 100.0 | 1.88 | 1.88 |
| Hoeing | 69.7 | .70 | 1.00 |
| Cultivation | 100.0 | 4.67 | 4.67 |
| Irrigation | 100.0 | 1.33 | 1.33 |

[1] Based on 33 observations.

[2] An average of every 4.0 years.

**Appendix Table 72.—SOYBEANS, non-irrigated: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 25. | 25. |
| Pounds of N | .7 | 1. | 72. |
| Subsoiling[2] | .7 | ------- | ------- |
| Land forming | 1.9 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.4 | .03 | 1.00 |
| Discing, fall | 37.7 | .44 | 1.16 |
| Middle breaking, fall | 84.0 | .85 | 1.01 |
| Flat breaking, spring | .4 | [3] | 1.00 |
| Discing, spring | 95.9 | 1.40 | 1.46 |
| Middle breaking, spring | 90.3 | .93 | 1.03 |
| Harrowing | 99.6 | 1.76 | 1.76 |
| Pre-emerge | .7 | .01 | 1.00 |
| Hoeing | 69.4 | .72 | 1.03 |
| Cultivation | 97.4 | 4.73 | 4.86 |

[1] Based on 268 observations.

[2] An average of every 2.0 years.

[3] Less than .05 pounds.

**Appendix Table 73.—OATS: Normal yield per acre and production practices, soil mapping unit 134, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 58. | 58. |
| Pounds of N | 100.0 | 44. | 44. |
| Subsoiling[2] | 4.8 | ------- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.8 | .05 | 1.00 |
| Discing, fall | 100.0 | 2.29 | 2.29 |
| Harrowing | 100.0 | 1.52 | 1.52 |
| Post-emerge | 61.9 | .62 | 1.00 |
| Insecticides | 100.0 | 1.00 | 1.00 |

[1] Based on 21 observations.

[2] An average of every 3.0 years.

**Appendix Table 74.—OATS: Normal yield per acre and production practices, soil mapping unit 136, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 58. | 58. |
| Pounds of N | 95.6 | 42. | 44. |
| Subsoiling[2] | 11.1 | - - - | - - - |
| Land forming | 2.2 | | |
| Other practices (times over). | | | |
| Flat breaking, fall | 6.7 | .09 | 1.33 |
| Discing, fall | 100.0 | 2.40 | 2.40 |
| Harrowing | 91.1 | 1.27 | 1.39 |
| Post-emerge | 55.6 | .56 | 1.00 |
| Insecticides | 73.3 | .73 | 1.00 |

[1] Based on 45 observations.

[2] An average of every 2.8 years.

**Appendix Table 75.—OATS: Normal yield per acre and production practices, soil mapping unit 312, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 57. | 57. |
| Pounds of N | 100.0 | 45. | 45. |
| Subsoiling[2] | 4.2 | | - - - |
| Land forming | 2.1 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 4.2 | .04 | 1.00 |
| Discing, fall | 100.0 | 2.73 | 2.73 |
| Harrowing | 100.0 | 1.79 | 1.79 |
| Post-emerge | 58.3 | .58 | 1.00 |
| Insecticides | 91.7 | .92 | 1.00 |

[1] Based on 48 observations.

[2] An average of every 3.5 years.

**Appendix Table 76.—OATS: Normal yield per acre and production practices, soil mapping unit 322, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 57. | 57. |
| Pounds of N | 100.0 | 44. | 44. |
| Land forming | 1.6 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.3 | .06 | 1.00 |
| Discing, fall | 100.0 | 2.62 | 2.62 |
| Harrowing | 96.8 | 1.51 | 1.56 |
| Post-emerge | 47.6 | .48 | 1.00 |
| Inserticides | 96.8 | .98 | 1.02 |

[1] Based on 63 observations.

**Appendix Table 77.—OATS: Normal yield per acre and production practices, soil mapping unit 333, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 58. | 58. |
| Pounds of N | 100.0 | 48. | 48. |
| Other practices (times over): | | | |
| Flat breaking, fall | 27.3 | .27 | 1.00 |
| Discing, fall | 100.0 | 2.45 | 2.45 |
| Harrowing | 90.9 | 1.45 | 1.60 |
| Post-emerge | 63.6 | .64 | 1.00 |
| Insecticides | 100.0 | 1.00 | 1.00 |

[1] Based on 11 observations.

Appendix Table 78.—OATS: Normal yield per acre and production practices, soil mapping unit 423, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 56. | 56. |
| Pounds of N | 100.0 | 42. | 42. |
| Subsoiling[2] | 3.0 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.0 | .03 | 1.00 |
| Discing, fall | 100.0 | 2.78 | 2.78 |
| Harrowing | 93.9 | 1.33 | 1.42 |
| Post-emerge | 39.4 | .39 | 1.00 |
| Insecticides | 90.9 | .91 | 1.00 |

[1] Based on 33 observations.

[2] An average of every 3.0 years.

Appendix Table 79.—OATS: Normal yield per acre and production practices, soil mapping unit 424, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 55. | 55. |
| Pounds of N | 100.0 | 43. | 43. |
| Subsoiling[2] | 8.8 | — | — |
| Land forming | 2.9 | — | — |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.68 | 2.68 |
| Harrowing | 97.1 | 1.47 | 1.52 |
| Post-emerge | 44.1 | .44 | 1.00 |
| Insecticides | 94.1 | .94 | 1.00 |

[1] Based on 34 observations.

[2] An average of every 2.7 years.

Appendix Table 80.—OATS: Normal yield per acre and production practices, soil mapping unit 425, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 53. | 53. |
| Pounds of N | 100.0 | 42. | 42. |
| Subsoiling[2] | 14.6 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 2.1 | .02 | 1.00 |
| Discing, fall | 100.0 | 2.31 | 2.31 |
| Harrowing | 93.8 | 1.50 | 1.60 |
| Post-emerge | 39.6 | .40 | 1.00 |
| Insecticides | 93.8 | .94 | 1.00 |

[1] Based on 48 observations.

[2] An average of every 3.3 years.

Appendix Table 81.—OATS: Normal yield per acre and production practices, soil mapping unit 426, nearly level phase, Mississippi Delta Area, 1960[1].

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 53. | 53. |
| Pounds of N | 100.0 | 45. | 45. |
| Subsoiling[2] | 41.2 | — | — |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.47 | 2.47 |
| Harrowing | 94.1 | 1.18 | 1.25 |
| Post-emerge | 64.7 | .65 | 1.00 |
| Insecticides | 94.1 | .94 | 1.00 |

[1] Based on 17 observations.

[2] An average of every 3.0 years.

**Appendix Table 82.—OATS: Normal yield per acre and production practices, soil mapping unit 434, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 61. | 61. |
| Pounds of N | 100.0 | 44. | 44. |
| Subsoiling[2] | 14.8 | ------ | ------ |
| Land forming | 7.4 | ------ | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 18.5 | .19 | 1.00 |
| Discing, fall | 100.0 | 2.48 | 2.48 |
| Harrowing | 100.0 | 1.56 | 1.56 |
| Post-emerge | 40.7 | .41 | 1.00 |
| Insecticides | 81.5 | .85 | 1.05 |

[1] Based on 27 observations. [2] An average of every 2.5 years.

**Appendix Table 83.—OATS: Normal yield per acre and production practices, soil mapping unit 435, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 52. | 52. |
| Pounds of N | 97.8 | 44. | 45. |
| Pounds of $P_2O_5$ | 2.2 | 1. | 60. |
| Pounds of $K_2O$ | 2.2 | 1. | 60. |
| Subsoiling[2] | 32.6 | ------ | ------ |
| Land forming | 8.7 | ------ | ------ |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.26 | 2.26 |
| Harrowing | 100.0 | 1.48 | 1.48 |
| Post-emerge | 45.7 | .46 | 1.00 |
| Insecticides | 93.5 | .93 | 1.00 |

[1] Based on 46 observiations. [2] An average of every 2.9 years.

**Appendix Table 84.—OATS: Normal yield per acre and production practices, soil mapping unit 436, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 52. | 52. |
| Pounds of N | 100.0 | 43. | 43. |
| Subsoiling[2] | 50.0 | ------ | ------ |
| Other practices (times over): | | | |
| Flat breaking, fall | 3.1 | .06 | 2.00 |
| Discing, fall | 100.0 | 2.22 | 2.22 |
| Harrowing | 100.0 | 1.41 | 1.41 |
| Post-emerge | 71.9 | .72 | 1.00 |
| Insecticides | 96.9 | .97 | 1.00 |

[1] Based on 32 observations. [2] An average of every 3.2 years.

**Appendix Table 85.—OATS: Normal yield per acre and production practices, soil mapping unit 446, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 52. | 52. |
| Pounds of N | 100.0 | 47. | 47. |
| Subsoiling[2] | 27.8 | ------ | ------ |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.17 | 2.17 |
| Harrowing | 100.0 | 1.50 | 1.50 |
| Post-emerge | 61.1 | .61 | 1.00 |
| Insecticides | 94.4 | .94 | 1.00 |

[1] Based on 18 observations. [2] An average of every 3.0 years.

**Appendix Table 86.—OATS: Normal yield per acre and production practices, soil mapping unit 456, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 54. | 54. |
| Pounds of N | 100.0 | 42. | 42. |
| Subsoiling[2] | 37.1 | ... | .... |
| Land forming | 2.9 | | |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.31 | 2.31 |
| Harrowing | 94.3 | 1.31 | 1.39 |
| Post-emerge | 68.6 | .69 | 1.00 |
| Insecticides | 97.1 | .97 | 1.00 |

[1] Based on 35 observations.
[2] An average of every 2.5 years.

**Appendix Table 87.—OATS: Normal yield per acre and production practices, soil mapping unit 825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 59. | 59. |
| Pounds of N | 100.0 | 44. | 44. |
| Subsoiling[2] | 9.1 | .... | .... |
| Other practices (times over): | | | |
| Flat breaking, fall | 9.1 | .09 | 1.00 |
| Discing, fall | 100.0 | 2.09 | 2.09 |
| Harrowing | 81.8 | 1.45 | 1.78 |
| Post-emerge | 27.3 | .27 | 1.00 |
| Insecticides | 90.9 | .91 | 1.00 |

[1] Based on 11 observations.
[2] An average of every 3.0 years.

**Appendix Table 88.—OATS: Normal yield per acre and production practices, soil mapping unit T825, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 64. | 64. |
| Pounds of N | 100.0 | 58. | 58. |
| Land forming | 15.4 | | .. |
| Other practices (times over): | | | |
| Flat breaking, fall | 15.4 | .15 | 1.00 |
| Discing, fall | 100.0 | 2.08 | 2.08 |
| Harrowing | 100.0 | 1.50 | 1.50 |
| Insecticides | 100.0 | 1.08 | 1.08 |

[1] Based on 13 observations.

**Appendix Table 89.—OATS: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 54. | 54. |
| Pounds of N | 98.4 | 43. | 44. |
| Pounds of $P_2O_5$ | .5 | [3] | 60. |
| Pounds of $K_2O$ | .5 | [3] | 60. |
| Subsoiling[2] | 31.2 | .... | .... |
| Land forming | 3.7 | ... | |
| Other practices (times over): | | | |
| Flat breaking, fall | 2.6 | .04 | 1.40 |
| Discing, fall | 100.0 | 2.28 | 2.28 |
| Harrowing | 96.8 | 1.40 | 1.44 |
| Post-emerge | 58.7 | .59 | 1.00 |
| Insecticides | 89.9 | .90 | 1.00 |

[1] Based on 189 observations.
[2] An average of every 2.8 years.
[3] Less than .5 pounds.

**Appendix Table 90.—OATS: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 57. | 57. |
| Pounds of N | 100.0 | 44. | 44. |
| Subsoiling[2] | 11.1 | — | — |
| Land forming | 2.3 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.5 | .06 | 1.00 |
| Discing, fall | 99.1 | 2.44 | 2.46 |
| Harrowing | 94.9 | 1.44 | 1.52 |
| Post-emerge | 43.1 | .43 | 1.00 |
| Insecticides | 92.6 | .94 | 1.01 |

[1] Based on 216 observations.

[2] An average of every 3.0 years.

**Appendix Table 91.—OATS: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 56. | 56. |
| Pounds of N | 100.0 | 45. | 45. |
| Subsoiling[2] | 1.6 | — | — |
| Land forming | 1.6 | | |
| Other practices (times over): | | | |
| Flat breaking, fall | 6.6 | .07 | 1.00 |
| Discing, fall | 100.0 | 2.66 | 2.66 |
| Harrowing | 98.4 | 1.65 | 1.68 |
| Post-emerge | 47.5 | .48 | 1.00 |
| Insecticides | 95.1 | .96 | 1.01 |

[1] Based on 122 observations.

[2] An average of every 3.5 years.

**Appendix Table 92.—WHEAT: Normal yield per acre and production practices, soil mapping unit 312, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 27. | 27. |
| Pounds of N | 100.0 | 44. | 44. |
| Land forming | 10.0 | | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 15.0 | .15 | 1.00 |
| Discing, fall | 100.0 | 2.50 | 2.50 |
| Harrowing | 95.0 | 1.80 | 1.89 |
| Post-emerge | 65.0 | .65 | 1.00 |
| Insecticides | 85.0 | .85 | 1.00 |

[1] Based on 20 observations.

**Appendix Table 93.—WHEAT: Normal yield per acre and production practices, soil mapping unit 322, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 28. | 28. |
| Pounds of N | 100.0 | 47. | 47. |
| Land forming | 6.7 | — | — |
| Other practices (times over): | | | |
| Flat breaking, fall | 20.0 | .20 | 1.00 |
| Discing, fall | 100.0 | 2.40 | 2.40 |
| Harrowing | 100.0 | 1.57 | 1.57 |
| Post-emerge | 40.0 | .40 | 1.00 |
| Insecticides | 66.7 | .73 | 1.10 |

[1] Based on 15 observations.

**Appendix Table 94.—WHEAT: Normal yield per acre and production practices, soil mapping unit 423, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 29. | 29. |
| Pounds of N | 100.0 | 43. | 43. |
| Subsoiling[2] | 20.0 | ------ | ------ |
| Land forming | 20.0 | ----- | |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.70 | 2.70 |
| Harrowing | 100.0 | 1.30 | 1.30 |
| Post-emerge | 40.0 | .40 | 1.00 |
| Insecticides | 70.0 | .70 | 1.00 |

[1] Based on 10 observations.

[2] An average of every 2.5 years.

**Appendix Table 95.—WHEAT: Normal yield per acre and production practices, soil mapping unit 425, nearly level phase, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 28. | 28. |
| Pounds of N | 100.0 | 40. | 40. |
| Subsoiling[2] | 20.0 | ---- | ----- |
| Other practices (times over): | | | |
| Discing, fall | 100.0 | 2.20 | 2.20 |
| Harrowing | 90.0 | 1.50 | 1.67 |
| Post-emerge | 30.0 | .30 | 1.00 |
| Insecticides | 80.0 | .80 | 1.00 |

[1] Based on 10 observations.

[2] An average of every 3.0 years.

**Appendix Table 96.—WHEAT: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 28. | 28. |
| Pounds of N | 100.0 | 49. | 49. |
| Subsoiling[2] | 23.5 | ------ | ---- |
| Other practices (times over): | | | |
| Flat breaking, fall | 11.8 | .12 | 1.00 |
| Discing, fall | 100.0 | 2.41 | 2.41 |
| Harrowing | 100.0 | 1.47 | 1.47 |
| Post-emerge | 64.7 | .65 | 1.00 |
| Insecticides | 82.4 | .82 | 1.00 |

[1] Based on 17 observations.

[2] An average of every 2.8 years.

**Appendix Table 97.—WHEAT: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 28. | 28. |
| Pounds of N | 100.0 | 42. | 42. |
| Subsoiling[2] | 11.1 | ------- | ------- |
| Land forming | 6.7 | ----- | ------- |
| Other practices (times over): | | | |
| Flat breaking, fall | 13.3 | .16 | 1.17 |
| Discing, fall | 97.8 | 2.29 | 2.34 |
| Harrowing | 97.8 | 1.47 | 1.50 |
| Post-emerge | 40.0 | .40 | 1.00 |
| Insecticides | 80.0 | .82 | 1.03 |

[1] Based on 45 observations.

[2] An average of every 2.8 years.

**Appendix Table 98.—Wheat: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, bushels | 100.0 | 27. | 27. |
| Pounds of N | 100.0 | 47. | 47. |
| Land forming | 7.7 | ....... | ....... |
| Other practices (times over): | | | |
| Flat breaking, fall | 17.9 | .18 | 1.00 |
| Discing, fall | 100.0 | 2.46 | 2.46 |
| Harrowing | 94.9 | 1.64 | 1.73 |
| Post-emerge | 51.3 | .51 | 1.00 |
| Insecticides | 76.9 | .79 | 1.03 |

[1] Based on 39 observations.

**Appendix Table 99.—HAY: Normal yield per acre and production practices, sandy soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, tons | 100.0 | 2.12 | 2.12 |
| Subsoiling[2] | 10.0 | ....... | ....... |
| Other practices (times over): | | | |
| Flat breaking, fall | 20.0 | .20 | 1.00 |
| Discing, fall | 40.0 | 1.10 | 2.75 |
| Harrowing | 40.0 | .70 | 1.75 |
| Insecticides | 10.0 | .10 | 1.00 |

[1] Based on 10 observations.

[2] An average of every 2.0 years.

**Appendix Table 100.—HAY: Normal yield per acre and production practices, mixed soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, tons | 100.0 | 2.53 | 2.53 |
| Pounds of $P_2O_5$ | 8.3 | 4. | 50. |
| Pound of $K_2O$ | 8.3 | 4. | 50. |
| Subsoiling[2] | 16.7 | ....... | ....... |
| Other practices (times over): | | | |
| Flat breaking, fall | 29.2 | .42 | 1.43 |
| Discing, fall | 45.8 | 1.17 | 2.55 |
| Discing, spring | 12.5 | .25 | 2.00 |
| Harrowing | 54.2 | 1.00 | 1.85 |
| Insecticides | 20.8 | .29 | 1.40 |

[1] Based on 24 observations.

[2] An average of every 2.2 years.

**Appendix Table 101.—HAY: Normal yield per acre and production practices, clay soils, Mississippi Delta Area, 1960[1].**

| Item | Percentage reporting | Average for all farmers | Average for farmers reporting |
|---|---|---|---|
| Yield, tons | 100.0 | 1.77 | 1.77 |
| Pounds of N | 4.8 | 2. | 50. |
| Land forming | 4.8 | ....... | ....... |
| Other practices (times over): | | | |
| Flat breaking, fall | 14.3 | .14 | 1.00 |
| Discing, fall | 19.0 | .38 | 2.00 |
| Discing, spring | 14.3 | .33 | 2.33 |
| Harrowing | 33.3 | .67 | 2.00 |
| Irrigation | 4.8 | .05 | 1.00 |
| Insecticides | 4.8 | .05 | 1.00 |

[1] Based on 21 observations.

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# Factors Affecting Soybean Yields

## In the Delta Area of Mississippi

By FRED T. COOK, Jr. and
A. M. HEAGLER

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

In cooperation with Farm Economics Division, Economics
Research Service, U. S. Department of Agriculture

## Conclusions

These results indicate that a May 10 planting date and the use of rotations are closely followed by farmers who consistently produce yields of soybeans which are higher than the average for the area. Research at the Delta Branch Experiment Station[3] has shown that May 10 is the optimum average date for planting soybeans if good yields are to be made. The study indicates that this planting date results in higher yields under farm conditions.

The use of rotations is also important in producing high yields of soybeans. The principal effect of rotations is that of weed control. Soybeans that follow cotton, rice, or fallowed land have fewer weeds than those following soybeans or corn.

The use of recommended soybean varieties is associated with the high yields. Seventy-six percent of all farmers in the group with low average yields planted the recommended varieties. This does not mean that the recommended varieties are not superior to varieties that are not as well adapted to the area. Rather it indicates that these farmers are not getting the fullest benefit from improved varieties. A farmer who plants a good variety of soybeans at the wrong time and does not control weeds is likely to get low yields.

Use of one good practice alone will not insure high yields of soybeans. Combination of all practices used to produce soybeans determine yields in any one year. Weather permitting good yields of soybeans result when good varieties are planted at the correct time and weed control is effective.

Since production costs were virtually the same for the three yield groups, it follows that farmers who obtain the higher yields have higher net returns. A substantial increase in returns can be achieved with improved practices and management in soybean production.

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[3] Hartwig, E. E., "Factors Affecting Time of Planting Soybeans in the Southern States," U. S Dept. Agr. Cir. 934. July 1954.

# FACTORS AFFECTING SOYBEAN YIELDS IN THE DELTA

By FRED T. COOK, JR.[2] and A. M. HEAGLER[2]

Soybean production in the Mississippi Delta has increased tremendously during the last 20 years. In 1940, only 24,400 acres of the crop were harvested for beans in the area. By 1959, this acreage had risen to 743,000, 30 times the 1940 acreage.

A part of this growth can be attributed to the need for profitable uses of land diverted from cotton production by acreage allotments. In some respects, however, soybeans are a natural supplementary crop. Except for harvesting, they can be produced with the same equipment used to produce cotton. Soybeans require only nominal amounts of labor since production of the crop is almost completely mechanized. In the Delta, little or no fertilizer is required and soybeans are not completely competitive with cotton for land. Soybeans grow well on heavy clay land that is not particularly suited to cotton production.

Increased yields of soybeans have no doubt contributed to their popularity. In the last 20 years, average yields in the Delta have virtually doubled, rising from 12 to almost 20 bushels. Most of this increase is a result of improved varieties and better management practices.

Despite the strides made in soybean production in the Delta, certain problems persist. Yields continue to vary widely from farm to farm and from season to season. Furthermore, research at the Delta Branch Experiment Station indicates that yields much higher than those currently realized in the area are possible if recommended production practices are followed.

Several possible explanations of yield variability among farms come to mind. The most obvious explanation is superior management on the part of producers with consistently high yields. But management is a nebulous thing when it comes to quantitative measurement.

Soil type may affect soybean yields as it does cotton yields. Associated with soil type is drainage, both surface and internal, always important in the production of any crop in the area.

Specific cultural practices, such as planting dates, number of cultivations, insect control, and others, may also affect yields. Inter-relationships among these operations and timeliness may be of particular importance.

Some of the major factors affecting soybean yields are evaluated here. Costs associated with soybean production in the Delta are presented.

## Procedure

A stratified random sample of farms in 12 Delta counties was drawn from county ASC files and 214 farmers were interviewed. Farms with less than 150 acres of cropland were excluded from the sample in order to get operations with sizable bean acreages. From the 214 farmers, 512 separate observations of different fields were obtained. A separate observation was made for soybeans grown on each soil type and for each variety

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[1] Study conducted jointly by the Farm Economics Division, Economic Research Service, U. S. Department of Agriculture and the Mississippi Agricultural Experiment Station.

[2] Agricultural Economists, Farm Economics Division, ERS, USDA, stationed at the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Miss.

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grown. Soybeans planted on land from which oats had been harvested in the same year were also handled as separate observations.

### Method of Analysis

The study attempted to determine those practices used by producers obtaining high yields.

Farms included in the study were divided into three groups based on the 5-year average yield of soybeans as reported by the farmer. Five-year average yields of 28 to 40 bushels placed the farm in the high-yielding group; those of 22 to 27 bushels in the intermediate-yield group, and those with yields of less than 21 bushels in the low-yielding group. Of the 214 farmers interviewed, 30 percent operated high-yield farms, 42 percent in intermediate-yield farms, and 28 percent low-yield farms.

The number of farmers in each group who used a particular practice was counted, and if a significant difference in percentage of use was found among groups, it was assumed that this practice had some effect on yield. But it cannot be assumed that when no difference was found, the particular practice did not affect yields. Some practices are universally used by all farmers and thus no difference is indicated. The management of a practice, such as timeliness, cannot be measured. Thus the effectiveness of any practice varies from farm to farm. A good example of this is in evaluating number of cultivations. The number can be important but the effectiveness of each cultivation is greatly influenced by the size and amount of weed and grass infestation at the time of cultivation.

### Results

The average farm in the sample had 1,085 acres of cropland, of which 328 acres were used to produce cotton, 390 acres were planted to soybeans only, and an additional 37 acres of soybeans were planted after oats were harvested.

Of the items that affect soybean yields, the first to be explored are the variety and quality of seed, and the date and rate of planting. At the time this sudy was conducted, three soybean varieties—Lee, Jackson, and Hood—were recommended for the Mississippi Delta by the Experiment Station. Eighty-two percent of all farmers in the study planted only these recommended varieties. Eighty-five percent of the farmers with high yields planted these varieties and 75 percent of the farmers with low yields grew them. Although a majority of all farmers planted recommended varieties, this study indicates that farmers with high yields believed these varieties to be important contributors to high yields.

Quality of seed planted affects the stand density and yield. All farmers reported that they inoculated soybean seed if planted in a field that had not been planted to soybeans for several years. If they used home-grown seed, essentially all of these farmers cleaned it before planting. All purchased seed was cleaned. About 85 percent of all farmers interviewed checked the germination of seed before planting.

The date of planting was closely associated with yields. May 10 is the recommended planting date for the area. Ninety percent of the farmers with high yields planted their soybeans within 10 days of this date. Seventy percent of the farmers with intermediate yields planted in this period, and but 53 percent of the low yielding group planted during this time Soybean specialists in the area consider time of planting one of the most important factors affecting yields, and the study bears this out. Among farmers with high yields who did not plant during this period, most indicated that they wanted to plant around May 10 but could not because of adverse weather. In the lower yield groups, a great deal of planting was done before May 10.

Most of the farmers interviewed planted one bushel—60 pounds—of seed per acre. There was so little variation from this that no evaluation of greater or lesser seeding rates could be made. The recommended seeding rate is about 40 pounds per acre, or one seed per inch of row. Of the farmers interviewed, more reported planting over 60 pounds per acre than under 60 pounds. Most farmers indicated that they seeded heavily to insure a good stand, but soybean specialists at the Delta Experiment Station believe that a too heavy plant population can contribute to lower yields.

Other practices such as fertilization irrigation, insect control, and use of herbicides were considered in the study. The number of farmers using any one of these practices generally was too low for a sound evaluation to be made. However. there was some evidence of positive relationship between use of herbicides and yields. Farmers with the higher yields used more herbicides than the other groups. It is felt that this indicates a greater concern for weed control among farmers in this group. Since only 11 percent of the high-yielding group used herbicides and this on a limited basis, the effect of this practice on soybean yields could not be isolated.

Producers indicated that soil types greatly affect soybean yields. When yields were averaged for a 5-year period, little difference was found among soil types The soils were grouped into three types —sandy, loam, and clay or buckshot. The 5-year average yield for each soil type and for each yield group on these soils is presented in table 1. Variability of yields was greatest on sandy soils. In dry years, yields on sandy soils were low; in wet years, they were high. One farm reported a yield of 8 bushels per acre on sandy soils in a dry year and 42 bushels per acre on the same soils in a wet year. Loam soils had the next greatest variability in yield, and clay soils the least variation in yield over the 5-year period.

The effect of rotations on soybean yields was intensively explored. Fifty-two percent of the farmers in the high-yielding group reported that they attempted to follow a definite rotation with soybeans. An additional 21 percent of this group used some rotation. Thirty-seven percent of the farmers in the intermediate-yield group tried to follow a definite rotation, and another 12 percent used it to a limited extent. Only 17 percent of the low-yield group had a rotation program. Rotations with a specific crop, such as cotton or rice, had no apparent advantage in terms of soybean yields. For purposes of this study, fallow was considered as a component of a rotation. All farmers who used rotations said that yields were somewhat higher on rotated than on non-rotated fields.

Definite rotations were more often used on farms with little variation in soil types. Farmers are naturally reluctant to move cotton to less desirable soils for the sake of a rotation. Farms with fairly uniform soils are more easily adapted to a rotation system. Farmers who used rotations in producing soybeans did so primarily as a weed-control measure. Fields that have been in cotton, rice, or were fallowed usually have less weed infestations than fields that have been in soybeans for a number of years. Many farmers felt that soybeans grown in rotation with

**Table 1.—Average yields of soybeans, by yield groups and soil types, 1955-59**

| Yield group | Number of farms | Soil group<br>Clay | <br>Loam | <br>Sand |
|---|---|---|---|---|
| | | Bushels | Bushels | Bushels |
| Farms with high yields | 64 | 31.3 | 31.4 | 30.5 |
| Farms with intermediate yields | 90 | 24.2 | 25.7 | 23.6 |
| Farms with low yields | 60 | 18.4 | 19.2 | 18.6 |
| All farms | 214 | 24.3 | 25.4 | 24.4 |

such crops as cotton and rice improved the yields of these crops, but no evaluation of this phase of the rotation was made.

Specialized equipment, such as double disk openers, planter press wheels, rotary hoes, and stalk shredder attachments, used to produce soybeans were found on so few farms that their effect on yield could not be evaluated.

Many farmers indicated that certain specific operations or combinations of specific operations involved in seedbed preparation, planting, and cultivation would result in higher soybean yields. A complete breakdown of every operation involved in producing a soybean crop for each soil type was obtained from each operator included in the study. No operation or combination of operations was found to have a specific relationship to yields.

The only significant differences in operations were between soil types. On sandy soils, disking and bedding were usually done after March 15. Seedbed conditioning is usually done in sandy soils with a harrow or tumbling stalk cutter-harrow combination tool. Planting is done on a bed. On sandy soils, the crop is usually cultivated five times. On clay soils, if possible, disking and bedding is usually done before March 15. The other practices are about the same except that usually the soybeans are cultivated only four times. Loam or mixed soils are usually handled the same as clay soils except when the farm has a predominance of sandy soils. Then the loam soils are tilled like sandy soils. Little deep plowing, moldboarding or subsoiling was done on fields to be planted in soybeans.

Performance rates for each operation were obtained and used to determine costs of producing an acre of soybeans to each of the three soil types. Those operations found to be most common for each soil type were used to develop these costs. Individual farm operations that vary from this mode would naturally change these production costs. Table 2 presents the costs associated with producing an acre of soybeans on sandy, loam, and clay soils. The table points out that total costs of production vary little among soil types, despite differences in seedbed preparation and cultivation associated with each soil. Clay soils have higher seedbed preparation costs than sandy soils, but cultivation and weeding are less than the clay soils. This tends to equalize costs among soil types.

**Table 2.—Production cost for one acre of soybeans, clay, loam, and sandy soils**

| Item | Unit | Price | Soil Group | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Clay | | Loam | | Sand | |
| | | | Quantity | Amount | Quantity | Amount | Quantity | Amount |
| | | Dollars | | Dollars | | Dollars | | Dollars |
| Tractor operation | hours | 1.79 | 2.6 | 4.65 | 2.6 | 4.65 | 2.6 | 4.65 |
| Equipment operation | hours | —— | 2.6 | 2.99 | 2.6 | 3.37 | 2.6 | 2.24 |
| Combine | hours | 6.14 | .6 | 3.68 | .5 | 3.07 | .5 | 3.07 |
| Haul | bushels | .05 | 24.3 | 1.22 | 25.4 | 1.27 | 24.4 | 1.22 |
| Seed | bushels | 4.50 | 1.0 | 4.50 | 1.0 | 4.50 | 1.0 | 4.50 |
| Weeding | hours | .35 | 1.8 | .63 | 2.3 | .80 | 2.3 | .80 |
| Labor | hours | .50 | 5.4 | 2.70 | 5.6 | 2.80 | 4.9 | 2.45 |
| Interest on operating capital[1] | —— | —— | —— | .46 | —— | .48 | —— | .44 |
| Total specified costs | —— | —— | —— | 20.83 | —— | 20.94 | —— | 19.37 |

[1] Six percent for 6 months.

### Soybeans Following Oats

The above discussion refers only to soybeans that are not double-cropped. In the Mississippi Delta, it is common practice to plant soybeans following oats, that is, after the oat crop is harvested. Yields of soybeans planted after oats showed no significant difference between the three groups of farmers in the study. Yields ranged from 12 to 24 bushels per acre. The average yield for all farms in the study was 18 bushels per acre for soybeans produced in this way. As previously stated, farms that had high average yields for regular soybean production did not have higher yields than either of the other two groups on soybeans produced after oats. There were no indicated differences in practices or operations among yield groups.

Seedbed preparation did not differ significantly by soil type for beans planted following oats. Ninety-three percent of all farmers burned the oat straw, disked twice, and planted flat. These soybeans were usually cultivated three times, and a minimum of hand weeding was done. Table 3 presents the costs and returns from 1 acre of soybeans following oats.

### The Effect of Yield on Returns

Table 4 presents the costs and returns associated with average yields of high, intermediate, and low-yielding farms included in the study. Average production varies from 31 bushels per acre on high-yielding farms to 18.7 bushels per acre on low-yielding farms.

The preharvest costs associated with each yield group were intensively investigated, and no significant differences in costs were found among groups. As stated elsewhere, there was an indication that farmers with high yields gave more consideration to weed control than other yield groups, but this could not be measured in terms of more cultivations or hoeings.

Combine costs were found to vary somewhat with yields, but these variations were small. It is felt that the high-yielding producers probably manage harvesting, along with other practices, more efficiently and this would tend to offset somewhat higher harvesting costs associated with higher yields.

Since production costs were virtually the same for the three yield groups, it follows that farmers who obtained high yields had higher net returns. As shown

**Table 3.—Production costs and returns for 1 acre of soybeans planted following oats.**

| Item | Unit | Price | Quantity | Amount |
|---|---|---|---|---|
| | | Dollars | | Dollars |
| Soybeans | bushels | 1.96[1] | 18.0 | 35.28 |
| Expenses: | | | | |
| Tractor operation | hours | 1.79 | 1.9 | 3.40 |
| Equipment operation | hours | —— | 1.9 | 1.46 |
| Combine | hours | 6.14 | .5 | 3.07 |
| Haul | bushels | .05 | 18.0 | .90 |
| Seed | bushels | 4.50 | 1.0 | 4.50 |
| Weeding | hours | .35 | 1.1 | .38 |
| Labor | hours | .50 | 3.2 | 1.60 |
| Interest on operating capital[2] | —— | —— | —— | .37 |
| Total Specified costs | —— | —— | —— | 15.68 |
| Returns to land, management and general overhead | —— | —— | —— | 19.60 |

[1] 1959 seasonal average price per bushel received by farmers as reported by Misssisippi Crop Reporting Service.

[2] Six percent for 6 months.

in table 4, returns to the high-yielding group were larger by $11.93 per acre than returns for the intermediate yield group and $22.89 per acre higher than the low yielding group.

This study indicates that yields can be increased by better management rather than added physical inputs.

**Table 4.—Costs and returns for soybeans, with different levels of yield, Yazoo-Mississippi Delta, 1959.**

| Item | Unit | Price | Yield Group |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  |  |  | High |  | Intermediate |  | Low |  |
|  |  |  | Quantity | Amount | Quantity | Amount | Quantity | Amount |
|  |  | Dollars |  | Dollars |  | Dollars |  | Dollars |
| Income: |  |  |  |  |  |  |  |  |
| Soybeans | bushels | 1.96[1] | 31.0 | 60.76 | 24.5 | 48.02 | 18.7 | 36.65 |
| Expenses: |  |  |  |  |  |  |  |  |
| Preharvest | acres | 15.49 | 1.0 | 15.49 | 1.0 | 15.49 | 1.0 | 15.49 |
| Combine | hours | 6.14 | .6 | 3.68 | .5[2] | 3.19 | .5 | 3.07 |
| Haul | bushels | .05 | 31.0 | 1.55 | 24.5 | 1.23 | 18.7 | .94 |
| Total specified costs | — | — | — | 20.72 | — | 19.91 | — | 19.50 |
| Returns to land, management and general overhead | — | — | — | 40.04 | — | 28.11 | — | 17.15 |

[1] 1959 seasonal average price per bushel received by farmers as reported by Mississippi Crop Reporting Service.

[2] Performance rate actually 0.52 hours per acre.

BULLETIN 631 NOVEMBER 1961

# The Economics Of Beef Cattle Production In The Yazoo - Mississippi Delta

Beef cattle on Coastal Bermuda pasture in Delta

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

In Cooperation With
Farm Economics Division, Economic Research Service,
United States Department of Agriculture

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## CONCLUSIONS

This study shows that beef cattle production can be profitable in the Delta although on the average farm studied it was not.

The 13 more efficient producers averaged profitable returns from their beef cattle enterprises. Factors contributing to their success were:

(1) The reduction of permanent pasture acreage requirements and cost per animal by utilizing crop residues and/or coastal bermuda.

(2) Utilization of crop residue grazing to reduce supplemental feed costs by shortening the winter feeding period and the amounts of high quality feed required during the feeding period.

(3) The reduction in fencing and building capital investment per animal resulting from the more intensive use of permanent pasture coupled with crop residue grazing.

(4) Larger calf crops and heavier calves at sale time.

# THE ECONOMICS OF BEEF CATTLE PRODUCTION IN THE YAZOO-MISSISSIPPI DELTA[1]

By ARTHUR M. HEAGLER, FRED T. COOKE, JR., and GRADY B. CROWE[2]

## Introduction

The popular concept of a typical Mississippi Delta plantation is a large row crop farm producing cotton, soybeans, corn, rice, and other crops. Little, if any, livestock, other than workstock, is presumed to be found on these farms and until the last few years this assumption was generally true. With the imposition of acreage controls on cotton, which drastically reduced the acreage of this crop, and with only nominal success with some alternative crops, many Delta farmers have turned to livestock, especially beef cattle as a supplemental enterprise.

The increase in beef cattle numbers in the Yazoo-Mississippi Delta during the last few years has been marked. On January 1, 1950, there were 88,300 beef animals on Delta farms. By January 1, 1957, a peak of 372,000 head had been reached.[3] A slight decrease in numbers occurred in 1957 and 1958 when 2 poor crop years forced many farmers to sell some of their breeding stock. This was coupled with a sharp increase in the value of brood cows and breeding heifers as restocking in drought areas of the West got underway. Also helping to account for the decline in numbers was the forced sale of animals caused by an outbreak of anaplasmosis in Delta herds.

Despite these factors, there were 245,000 beef animals on Delta farms on January 1, 1959. This represents an increase of 117 percent over 1950.

Increases in cattle numbers intensified the need for additional research on this enterprise. Input-output information on crop enterprises has been kept fairly current, but input-output data on livestock enterprises at the farm level are scarce. A three-phase study was undertaken in 1955 to provide input-output data for beef cattle enterprises and pastures in the Yazoo-Mississippi Delta. It was expected that after careful analysis this information could be used as a guide by farmers who were considering establishing or expanding a beef cattle enterprise.

This report deals with the first phase of the three-phase study which is a general description of beef cattle enterprises as they are found on Delta farms. The information in this report was obtained by personal interview from a sample of 68 beef producers in the area. The information collected included land use, cropland organization, beef cattle inventories, livestock production practices, labor requirements, and practices used in the production and use of forage crops, including permanent and temporary pastures. Only farmers who had commercial beef cattle enterprises for at least 3 years were included in the study. No purebred or show animal herds were included.

Phase two of the study will be concerned with detailed pasture output data obtained from a series of intensive case

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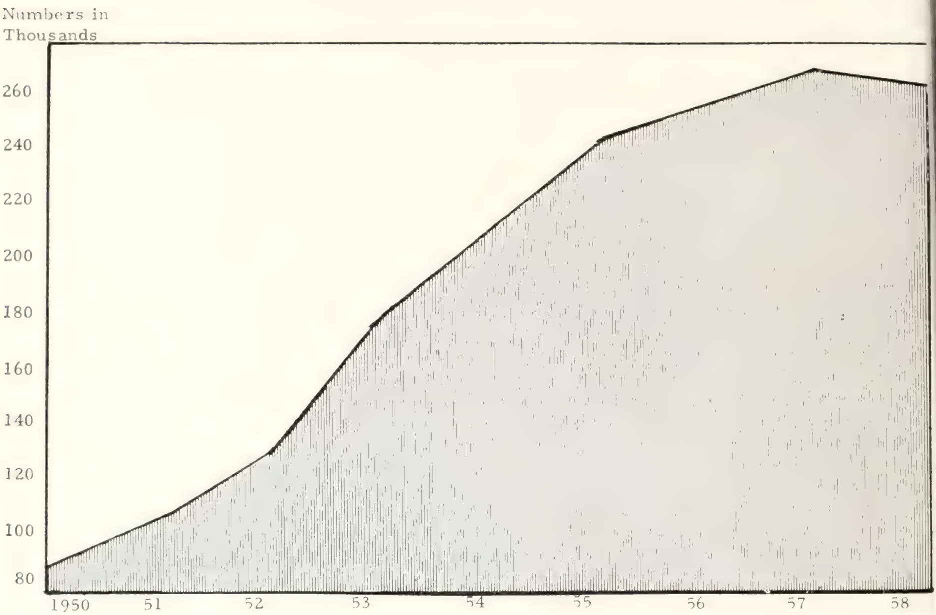
[1] This report is a part of a larger study of the Economics of Beef Cattle Production in the Delta. Additional reports covering results of other phases of the study are expected to be issued

[2] Agricultural Economists, Farm Economics Division, Economic Research Service, United States Department of Agriculture, stationed at the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Miss.

[3] Mississippi Agricultural Statistics 1956, Base Book Supplement No. 2 and Mississippi Crop and Livestock Reporting Service, Livestock Summary 1958-59.

Figure 1. Beef Cattle Numbers, Yazoo-Mississippi Delta, Mississippi, 1950-59



farm studies. The analysis will be concerned primarily with a comparison of yield relationships among different pasture grasses, with existing levels of pasture and herd management, and with their respective places in Delta grazing systems.

Phase three of the study will deal with the place of beef cattle in Delta farming systems. It will appraise how beef cattle might profitably fit into existing cropping patterns through fuller use of under-used resources or byproducts of present cropping systems.

### Land Use and Cropland Organization

Because of the nature of the enterprise, livestock farms are much larger than the average operating unit in the area. The average beef cattle farm studied contained slightly less than 2,000 acres of land, while the average unit for the area comprises only 332 acres. Because size of farm is important in beef cattle production, the farms studied were divided into two groups—small farms having less than 1,000 acres of land and large farms operating 1,000 acres or more (table 1). The small farms average 731 acres with 427 acres of cropland. Large farms averaged 2,420 acres of total land and 1,322 acres of cropland.

Size of farm apparently influenced very little the proportions of land devoted to specific uses. On the average farm, something less than 60 percent of the total acreage was devoted to cropland and about a third to pasture. Roughly 10 percent was in woods. Acreages indicated here as in pasture included some woodland used for pasture; about two-thirds of the farms studied utilized some kind of woodland pasture. Other uses accounted for 2 percent.

The fact that pastures occupied about a third of the total land farmed is one indication of the importance of the beef cattle enterprise on these farms. However, it also emphasizes the fact that livestock is still supplementary to crop production.

Cotton was the most important crop

grown on the farms studied; it occupied 36 percent of the cropland (table 2). Small farms tend to have a slightly higher proportion of cropland in this crop and a slightly lower proportion in soybeans. Soybeans occupy about a fourth of the cropland on the average and corn about 7 percent. So row crops account for roughly two-thirds of the cropland use. Small grains were grown on another 20 percent and the rest was devoted to silage and hay, temporary pastures, and miscellaneous uses. Some double cropping occurred as soybeans were planted after small grain and as small grains were used for temporary pasture and later harvested. The latter practice was used to a marked extent.

## Investment in the Beef Enterprise

**Beef Cattle.** The principal item of production in the beef enterprise is the breeding herd. Table 3 presents the average number of animals in each class of livestock found on the farms studied.

Two items of particular note should be pointed out in these data. Beef cattle producers in the Delta do not save enough heifers to meet the replacement requirements of their herds. Operators of small farms saved a lower percentage of replacement heifers than those of large farms. The average of all farms studied indicates that replacement heifers are saved at a rate of 8 percent per year. Usually, 15 to 20 percent is required.

**Table 1. — Land use, by size of farm, Yazoo-Mississippi Delta, 1957**

| | Farm size (acres) | | |
|---|---|---|---|
| Item | Under 1,000 | Over 1,000 | All farms |
| Number of farms | 18 | 50 | 68 |
| | | Average per farm | |
| | Acres | Acres | Acres |
| Land owned | 513 | 1,827 | 1,480 |
| Rented in | 246 | 598 | 505 |
| Rented out | 28 | 5 | 11 |
| Land operated | 731 | 2,420 | 1,974 |
| Cropland | 427 | 1,322 | 1,085 |
| Permanent pasture | 195 | 597 | 491 |
| Woods pasture | 34 | 198 | 154 |
| Woods not pastured | 63 | 263 | 210 |
| Other | 12 | 40 | 34 |

**Table 2. — Cropland organization, average per farm, by farm size group, Yazoo-Mississippi Delta 1957.**

| | Farm size (acres) | | |
|---|---|---|---|
| Item | Under 1,000 | Over 1,000 | All farms |
| | Acres | Acres | Acres |
| Cotton | 174 | 471 | 392 |
| Corn | 20 | 95 | 75 |
| Soybeans for beans | 92 | 358 | 288 |
| Small grains | 74 | 277 | 223 |
| Other crops | —— | 5 | 3 |
| Sorghum silage | 6 | 13 | 12 |
| Legume hay | 22 | 50 | 43 |
| Small grains grazed and harvested for grain | 28 | 92 | 75 |
| Temporary pasture | 25 | 44 | 39 |
| Acreage double cropped[1] | 18 | 37 | 32 |
| Idle | 17 | 34 | 29 |
| Soil Bank | 15 | 12 | 13 |

[1] Soybeans after small grain.

Table 3. — Average beef cattle numbers and investment per farm, by class of animal and size of farm, Yazoo-Mississippi Delta, 1957.

| Class of animal | Farm size (acres) Under 1,000 Number | Value | Over 1,000 Number | Value | All farms Number | Value |
|---|---|---|---|---|---|---|
| | | Dollars | | Dollars | | Dollars |
| Cows | 91 | 11,949 | 170 | 23,356 | 151 | 20,337 |
| Heifers | 2 | 428 | 17 | 1,899 | 13 | 1,510 |
| Bulls | 4 | 1,903 | 7 | 2,828 | 6 | 2,583 |
| Steers | 17 | 1,498 | 37 | 1,854 | 32 | 1,760 |
| Calves carried over | [1]12 | 216 | 40 | 1,000 | 31 | 744 |
| Calves born | [2]76 | —— | 136 | —— | 122 | —— |
| Total | 202 | 15,994 | 407 | 30,937 | 355 | 26,934 |

[2]Calves on hand beginning of year — January 1, 1957

[2]Calves born during year.

Table 4.—Investment per farm and per animal in buildings, grain storage, and corrals, by size of farm, Yazoo-Mississippi Delta, 1957.[1]

| Item | Farm size (acres) Under 1,000 Per farm | Per head[2] | Over 1,000 Per farm | Per head[2] | All farms Per farm | Per head[2] |
|---|---|---|---|---|---|---|
| | Dollars | Dollars | Dollars | Dollars | Dollars | Dollars |
| General barn | 1,501 | 7.43 | 2,380 | 5.85 | 2,147 | 6.05 |
| Hay shed | 1,135 | 5.62 | 1,954 | 4.80 | 1,737 | 4.89 |
| Grain storage | 1,527 | 7.56 | 1,698 | 4.17 | 1,653 | 4.66 |
| Silo | 365 | 1.81 | 2,238 | 5.50 | 1,742 | 4.91 |
| Corrals | 567 | 2.80 | 591 | 1.45 | 585 | 1.65 |
| Total | 5,095 | 25.22 | 8,861 | 21.77 | 7,864 | 22.16 |

[1]Investment represents replacement costs.

[2]For all animals.

Two factors seem to account for this situation. First, purchasing replacements, rather than "growing your own," has been an established practice in the area. Second, in an attempt to improve the quality of their herds, many producers are buying animals of higher quality as herd replacements.

As a general practice, late-dropped calves and the "light weight end" of the calf crop are carried over and taken to heavier weights than those at which calves are usually marketed.

For the most part, the steers shown in table 3 are animals saved and fed out on the farms on which they were produced.

Table 3 also indicates the capital investment per farm for each class of animal. Brood cows are the largest item of investment, accounting for more than 75 percent of the total regardless of size of farm.

**Buildings.** — Buildings, corrals, and grain storage are second only to livestock as an item of investment in beef cattle production. Replacement costs of these facilities per farm and per head of livestock are shown in table 4. Since the expansion in beef cattle production is relatively recent, most of these facilities have been constructed since World War II. For example, all of the corrals, 90 percent of the silos, and 70 percent of the grain bins were erected during that time. Most of the general-purpose barns and hay sheds, products of the "workstock for power" era, are much older. However, they have been remodeled and reconditioned into beef cattle facilities. This has been an important factor in keeping down the investment for these facilities.

This is one of the few items in which scale of operation had any influence on production inputs or returns. The data collected in this study were subjected to intensive analysis to determine the rela tionships between scale and costs and returns. No definite relationships other than this instance were found. This appears to be a management problem which will be discussed more fully later.

**Specialized Equipment.** — Certain specialized items, such as feeding equipment and watering systems, are used in beef cattle production. Investment in these items of equipment are shown in table 5. The cost of watering systems accounts for roughly two-thirds of the investment in specialized equipment. Almost 60 percent of the farms studied had wells as their only source of water and another 20 percent had a combination of wells and surface sources. Twenty percent of the farms used water from natural sources and ponds.

The use of general-purpose farm trailers helped to keep investment in feed-hauling equipment relatively low.

**Fencing.** — Four-strand barbed wire with posts spaced one rod apart is the most common type of permanent fence used in the Delta. Steel or wire stays are used between posts as necessary Fencing costs, as can be seen from the data in table 6, are an important investment item in producing beef cattle; they average almost $20 per animal.

Although large farms had 3 1/3 times as much pasture and only twice as many animals, large pastures reduced fencing costs per acre and per animal grazed.

The cost of fencing temporary pastures is relatively low because operators object to the use of permanent fencing for this purpose.

Temporary electric fencing is available at a cost of little over $46 per mile.[4] Electric fencing allows for excellent grazing control and is used extensively. Movement of the unit is simple and inexpensive.

Where permanent fencing or natural

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[4] Total cost per mile $46.61 Low-current battery-operated interrupted shock control $14.00; 6-volt dry-cell battery $3.17; 110 insulators $2.46; 1-mile 12-gauge smooth wire $18.98; labor $8.00; stakes of scrap material. The maximum capacity of the control unit and battery is 15 miles, thus fencing cost per mile decreases as mileage increases to the maximum.

Table 5. — **Investment per farm for specialized equipment used in beef production, by size of farm, Yazoo-Mississippi Delta, 1957.**

| Item | Farm size (acres) | | |
|---|---|---|---|
| | Under 1,000 | Over 1,000 | All farms |
| | Dollars | Dollars | Dollars |
| Creeps | 17 | 15 | 15 |
| Feed bunks | 353 | 615 | 560 |
| Feed carts | 35 | 148 | 118 |
| Feed grinder | 86 | 201 | 171 |
| Motors | 0 | 34 | 25 |
| Water systems | 952 | 1,930 | 1,671 |
| Total per farm | 1,443 | 2,943 | 2,560 |
| Total per head | 7.14 | 7.23 | 7.21 |

**Table 6. — Fencing cost, by size of farm, Yazoo-Mississippi Delta, 1957**

| Item | Farm size (acres) | | |
|---|---|---|---|
| | Under 1,000 | Over 1,000 | All farms |
| Miles of permanent fence | | | |
| Permanent pasture | 7.2 | 13.8 | 12.1 |
| Temporary pasture | .7 | 1.8 | 1.5 |
| Total per farm | 7.9 | 15.6 | 13.6 |
| Total cost per farm[1] | $3,959 | $7,817 | $6,815 |
| Total cost per head | $19.60 | $1921 | $19.20 |

[1] 4-strand barbed wire most common type. Replacement cost $501.11 per mile, from "Specified Production Costs for Cotton and Alternative Crops, Yazoo-Mississippi Delta" by Grady B. Crowe, Stoneville, Miss., March 1956.

barriers, such as drainage canals, exist on two or three sides of a temporary pasture, a "drover" is sometimes employed to herd the animals. This practice also holds down fencing costs.

**Summary of Investments.** — A summary of the capital investment items associated with beef cattle production is presented in table 7. Cattle account for 61 percent of the total investment. Buildings and fencing make up the bulk of the remainder.

### Breeding and Health Practices

The cow-calf enterprise found on Delta farms is usually built around a fall and winter calving program. Approximately 82 percent of the 1957 calf crop was dropped from October 1 to March 1. The calves are marketed the following summer at a weight of 350 to 450 pounds. Calves born toward the end of the calving period are usually carried over on small grain grazing or roughage and sold the following spring.

This type of calving program is widely used by beef producers in the area for several reasons. The more important ones are: (1) Brood cows are in better condition at calving time, (2) cows give more milk over a longer period of time because of the seasonal improvement in pastures, (3) calves escape flies, screw worms, and heat while young, and (4) calves are weaned and ready for sale between June 1 and September 1, the period when calf prices are usually highest.

The size of the calf crop is one of the chief factors affecting returns to the beef enterprise. Table 8 shows the calf crop percentages for the farms in this study. Small farms tend to have better calf crops than larger ones, probably because greater attention is given the smaller herds. Stillbirths and abortions are of major importance, accounting for 51 percent of all calf losses.

All farms studied used purebred bulls and grade brood cows. In some instances the bulls and part of the brood cows were registered. Seventy-nine percent of the operators of the farms surveyed reported brood cows to be predominantly a beef breed (80 percent or more beef blood). Only 4 percent of the operators reported brood cows predominantly of a dairy breed.

Shown in table 9 are the livestock health and sanitation practices found on the farms surveyed. The level of health and sanitation practices carried out was somewhat higher than that found in other beef-producing areas of the state.[5] Even so,

Table 7. — Summary of capital investment in the beef cattle enterprise per farm and per head, by size of farm, Yazoo-Mississippi Delta, 1957

| | Farm size (acres) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Under 1,000 | | | Over 1,000 | | | All Farms | | |
| | Investment | | | Investment | | | Investment | | |
| Item | Per farm | Per head | Percent of total | Per farm | Per head | Percent of total | Per farm | Per head | Percent of total |
| | Dollars | Dollars | Percent | Dollars | Dollars | Percent | Dollars | Dollars | Percent |
| Cattle | 15,994 | 79.18 | 61 | 30,937 | 76.01 | 61 | 26,934 | 75.87 | 61 |
| Buildings | 5,095 | 25.22 | 19 | 8,861 | 21.77 | 18 | 7,864 | 22.16 | 18 |
| Specialized equipment | 1,443 | 7.14 | 5 | 2,943 | 7.23 | 6 | 2,560 | 7.21 | 6 |
| Fencing | 3,959 | 19.60 | 15 | 7,817 | 19.21 | 15 | 6,815 | 19.20 | 15 |
| Total | 26,491 | 131.14 | 100 | 50,558 | 124.22 | 100 | 44,173 | 124.44 | 100 |

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[5] 'An Economic Appraisal of Beef Cattle Production in Northeast and East Central Mississippi." Miss. Agr. Expt. Sta. Bul. 497, State College. Miss., February 1947.

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"An Economic Appraisal of Beef Production in South Mississippi." Miss. Agr. Expt. Sta. Bul. 518, State College, Miss., April 1954.

**Table 8. — Percentage of calf crop, by size of farm, Yazoo-Mississippi Delta, 1957[1]**

| Size of farm | Calf crop |
|---|---|
| Acres | Percent |
| Under 1,000 | 84 |
| Over 1,000 | 80 |
| All farms | 81 |

**Table 9.—Livestock health practices, Yazoo-Mississippi Delta, 1957**

| Practice | Number herds receiving treatment | Percentage of herds treated | Percentage of all animals treated |
|---|---|---|---|
| Vaccination | Number | Percent | Percent |
| Anthrax | 43 | 63 | 70 |
| Blackleg | 63 | 93 | 93 |
| Malignant Edima | 36 | 53 | 60 |
| Bangs | 30 | 44 | 47 |
| Hemorrhagic septicemia | 12 | 18 | 16 |
| Leptospirosis | 9 | 13 | 14 |
| Other[1] | 4 | 6 | 11 |
| Grubs | 20 | 29 | 19 |
| Internal parasites | 47 | 69 | 74 |
| Spraying[2] | 53 | 78 | 86 |

[1] Anaplasmosis — 2; Pink eye — 2.

[2] Treated herds sprayed an average of 5.3 times.

**Table 10.—Major causes of death in beef cattle, Yazoo-Mississippi Delta, 1957.**

| Causes of death | Percentage of total deaths | |
|---|---|---|
| | Mature animals | Calves |
| | Percent | Percent |
| Diseases (all) | 70 | 10 |
| Anaplasmosis | 45 | --- |
| Forage poison | 14 | — |
| Bloat | 6 | — |
| Leptospirosis | 3 | 3 |
| Malignant edima | 1 | --- |
| Scours | ---- | 5 |
| Black leg | [1] | 2 |
| Other causes (all)[2] | 26 | 21 |
| Abortions | --- | 16 |
| Stillbirths | ---- | 35 |
| Unknown | 4 | 18 |
| Total | 100[3] | 100[4] |

[1] Less than 1 percent.

[2] Includes old age, accidents, calving, and weather.

[3] Cow death 2 percent of total numbers.

[4] Calf deaths 7 percent of total numbers.

vaccination for anthrax, leptospirosis. and septicemia were not up to recommended standards. Grubs are not a real problem in the area and less than a third of the herds were treated for them. Sixty-nine percent of the herds were treated for internal parasites, and 78 percent were sprayed an average of 5.3 times during the year.

The major causes of death of animals are shown in table 10. Anaplasmosis was the largest single cause of death among mature animals, accounting for 45 percent of the total. Abortions and stillbirths accounted for more than half of the calf losses. The average death loss per farm was 12 animals. Of the animals that died, 7.5 were calves, 4 were cows and heifers, and 0.5 were bulls and steers.

## Annual Costs Associated With the Beef Enterprise

Certain annual costs are associated with beef production. They consist primarily of the establishment and maintenance of pastures, feed and labor costs, upkeep of fencing and specialized equipment, and such miscellaneous items as veterinary fees, medicine, and salt.

**Pasture Costs.** — The chief item associated with beef production is pasture. It provides most of the feed for the cattle and is the major cash cost item. Shown in table 11 are the average establishment costs for the most common permanent pastures in the area. Seeding and fertilizer rates used are those reported by farmers; they are somewhat higher than the present recommended rates for the area. Cost rates for labor, power, and equipment use are those currently existing in the Delta. Four-row tractors and equipment are generally used in pasture establishment, except in the case of coastal bermuda, early plantings of which were sprigged in by hand. Now, however, both 2- and 4-row planting or sprigging machines are available, and their use sharply reduces labor requirements for this operation.

Pasture longevity in the Delta is rather short.[6] This is due primarily to two things: (1) Pastures are often located on soils with poor surface and internal drainage, and (2) poor grazing control and maintenance practices result in overgrazing and heavy weed infestations. Only common and coastal bermuda have an average length of life exceeding 7 years. Johnson and Dallis grasses are estimated to last only 5 years. Since pasture establishment costs are prorated over the life of the pasture, the length of life has an important effect on the annual charge to the beef enterprise. For example, the cost of establishing an acre of Dallis grass pasture amounts to $20 and the annual charge to $4.01. Comparable figures for Coastal Bermuda are $17.90 and $0.89.

Annual maintenance costs of permanent pastures consist primarily of fertilizer applications and clipping for weed control. They range from $1.49 per acre on fescue and wild winter peas to $10.96 on native pastures (table 12).

A total annual per acre charge for pastures is obtained by combining the an-

Table 11.—Permanent pasture establishment cost per acre, Yazoo-Mississippi Delta, 1957

| Pasture type | Seed | | Fertilizer[1] | | Labor, power and equipment | Total cost | Length of life | Cost per year |
|---|---|---|---|---|---|---|---|---|
| | Pounds | Dollars | Pounds | Dollars | Dollars | Dollars | Years | Dollars |
| Fescue | 13 | 9.40 | 120 | 4.50 | 5.88 | 19.78 | 7 | 2.83 |
| Common bermuda | 5 | 4.20 | 144 | 5.40 | 4.23 | 13.83 | 20 | .69 |
| Johnson | 25 | 3.00 | — | — | 5.80 | 8.80 | 5 | 1.76 |
| Dallis | 13 | 10.83 | 121 | 4.54 | 4.66 | 20.03 | 5 | 4.01 |
| Coastal | [2]14 | 6.28 | — | — | 13.01 | 26.30 | | 1.32[3] |
| bermuda | [2]14 | 6.28 | 187 | 7.01 | 4.61 | 17.90 | 20 | .89[4] |
| Fescue | 13 | — | — | — | — | — | | — |
| clover | 3 | 7.38 | 122 | 4.57 | 4.48 | 16.43 | 7 | 2.35 |
| Fescue | 13 | — | — | — | — | — | — | — |
| wild winter peas | 30 | 6.87 | 122 | 4.57 | 4.48 | 15.92 | 7 | 2.27 |

[1] Pounds of ammonium nitrate.

[2] Bushels.

[3] Hand sprigged.

[4] Machine sprigged.

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[6] Estimated pasture longevity based on experimental results from pasture studies conducted at the Delta Branch Experiment Station by Dr. P. G. Hogg, Assistant Superintendent and Agronomist.

Table 12.—Permanent pasture maintenance cost per acre, Yazoo-Mississippi Delta, 1957

| Pasture type | Seed | Fertilizer[1] | | Labor, power and equipment | Total cost | Annual cost per acre[4] |
|---|---|---|---|---|---|---|
| | Dollars | Pounds | Dollars | Dollars | Dollars | Dollars |
| Fescue | ...... | 115 | 4.31 | 2.16 | 6.47 | 9.30 |
| Common bermuda | ...... | 137 | 5.14 | 2.61 | 7.75 | 8.44 |
| Johnson | ...... | ...... | ...... | 2.34 | 2.34 | 4.10 |
| Dallis | ...... | 131 | 4.91 | 2.26 | 7.17 | 11.18 |
| Coastal | ...... | | | 3.10 | 10.49 | [2]11.81 |
| bermuda | ...... | 1.97 | 7.39 | 3.10 | 10.49 | [3]11.38 |
| Fescue clover | ...... | 200 | 7.50 | 1.49 | 8.99 | 11.34 |
| Fescue wild winter peas | ...... | ...... | ...... | 1.49 | 1.49 | 3.76 |
| Levee | .78 | 86 | 3.22 | 2.19 | 6.19 | 6.19 |
| Native | 2.97 | 134 | 5.02 | 2.97 | 10.96 | 10.96 |

[1] Pounds of ammonium nitrate.

[2] Hand sprigged.

[3] Machine sprigged.

[4] Includes prorated establishment costs.

nual cost of maintenance with the prorated establishment costs. The data are shown in table 12 for the major pasture types. These costs range from slightly less than $4.00 on fescue and wild winter peas to almost $12.00 per acre on coastal bermuda.

A variety of grasses may be utilized by the beef enterprise. However, intensive analysis of the pasture data indicate no important differences in pasture composition or annual cost per acre between small and large farms. A combination of fescue, Dallis, common bermuda, Johnson, and native grasses provided a major part of the grazing for the cow-calf enterprise on all farms. For a detailed breakdown of permanent pasture composition for cow-calf enterprises, see appendix table 1.

Small grains provided most of the grazing for steer enterprises. The average annual per acre charge of $15 was reduced to $3.65 by controlled grazing during late fall and winter and harvesting the grain the following spring. On all farms, 66 percent of the temporary grazing was handled in this way. On large farms, 68 percent, and on small farms 53 percent was so handled.

In addition to permanent pasture, temporary grazing crops are used to some extent in producing beef. Costs of producing these grazing crops are shown in table 13. Except for crop residue, which is unique because it represents a salvage operation, costs of temporary pastures are relatively high. For this reason, this type of feed is usually used only for steers. In cow-calf production, where wintering must be done as cheaply as possible, little, if any, use is made of temporary pastures.

For a detailed breakdown of labor, power, and equipment charges for establishing and maintaining permanent and temporary pastures, see appendix tables 2 and 3.

**Feed Costs.** — Another important item of expense to the livestock enterprise is the feed fed to cattle. Table 14 presents the types, average amount, and average value of supplemental feed fed in cow-calf programs, by farm size groups. On most farms, it was necessary to supplement the grazing program with feed from October through March. In 1957, the feeding period averaged 111 days for all farms. As table 14 indicates, roughages, such as hay and silage, and protein supplement accounted for most of the feed used in cow-calf production.

The cost of supplement feed for the mature animals in the cow-calf enter-

**Table 13.—Temporary pasture establishment costs per acre, Yazoo-Mississippi Delta, 1957.**

| Pasture type | Seed | | Fertilizer[1] | | Labor, power and equipment | Total |
|---|---|---|---|---|---|---|
| | Pounds | Dollars | Pounds | Dollars | Dollars | Dollars |
| Oats | [2]3.03 | 3.12 | 149 | 5.59 | 5.60 | 14.31 |
| Oats and ryegrass | [2]3.30<br>23.20 | 6.35 | 195 | 7.31 | 5.60 | 19.26 |
| Oats and wheat | [2]4.00<br>[2]2.00 | 11.04 | 163 | 6.11 | 5.60 | 22.75 |
| Rye grass | 20.00 | 1.60 | 125 | 4.69 | 5.60 | 11.89 |
| Rye grass and clover | 30.00<br>5.00 | 6.00 | 100 | 3.75 | 5.60 | 15.35 |
| Wheat | [2]2.25 | 6.75 | 150 | 5.62 | 5.60 | 17.97 |
| Sudan | 16.60 | 3.42 | 142 | 5.31 | 4.76 | 13.49 |
| Millet | 15.00 | 2.10 | 112 | 4.20 | 4.78 | 11.08 |
| Lespedeza | ---- | 7.35 | -- -- | ------ | 1.45 | 8.80 |
| Crop residue | ------ | ------ | ------ | —— | 1.16 | 1.16 |

[1]Ammonium nitrate.

[2]Bushels.

**Table 14.—Type, amount, and value of feed fed per farm and per animal, by size of farm, cow-calf enterprise, Yazoo-Mississippi Delta, 1957.**

| Item | Farm size (acres) | | All farms |
|---|---|---|---|
| | Under 1,000 | Over 1,000 | |
| Protein supplement | | | |
| Amount — tons | 4.1 | 14.2 | 11.5 |
| Cost — dollars | 287 | 998 | 810 |
| Concentrate | | | |
| Amount — bushels[1] | 67 | 145 | 125 |
| Cost — dollars | 69 | 128 | 112 |
| Roughage — ton | | | |
| Hay | 58.3 | 89.4 | 81.3 |
| Cost — dollars | 1,166 | 1,789 | 1,624 |
| Silage | 43.1 | 124.4 | 102.9 |
| Cost — dollars | 172 | 498 | 412 |
| Other[2] | | | |
| Amount | ------ | ------ | ------ |
| Cost — dollars | 4 | 24 | 19 |
| Cost per farm — dollars | 1,698 | 3,437 | 2,977 |
| Cost per cow — dollars | 17.51 | 17.71 | 17.51 |

[1]Corn equivalent.

[2]Includes range cubes and molasses.

prise averaged $17.51 per head for all farms. Hay accounted for 48 percent of the total feed cost per head, protein supplement 30 percent, silage 15 percent, and cottonseed hulls 7 percent. Each animal received an average of 1,211 pounds of silage, 769 pounds of hay, 138 pounds of protein supplement, and 116 pounds of cottonseed hulls.

All of the grain and purchased mixed feed fed in the cow-calf program was used to creep-feed calves. Calves are generally creep fed very lightly the last 6 weeks before weaning. The cost per calf averaged $0.73 for all farms.

Similar information on feed for the steer enterprise is shown in table 15. Steer - feeding enterprises were built around a small grain-grazing program followed by drylot summer feeding. Operators of small farms tended to use a short feeding period for steers while those of the larger farms fed steers for a longer period. The average feeding period was 122 days on all farms. The longer feeding period accounted for the higher per head cost of feeding steers on large farms. Grain, particularly corn, and protein supplement made up 43 percent of the ration fed steers.

Feed cost per steer averaged $27.19 for all farms. Grain accounted for 46 percent of the total feed cost per head, hay 25 percent, protein supplement 23 percent, and silage 6 percent. Each steer received approximately 22 pounds of feed per day; 7.7 pounds of grain, 6.7 pounds of silage, 5.6 pounds of hay, and 1.4 pound of silage, 5.6 pounds of hay, and 1.4 pounds of protein supplement. The large amount of roughage fed affected the level of finish on steers for all farms.

**Labor Costs.** — It was not possible to determine the total labor requirements for the beef enterprise. However, certain items of labor, such as time required for feeding, castrating, dehorning, branding and spraying, have been identified. Costs of labor used in feeding, by size of farm and for all farms, are shown in table 16. The per hour labor cost is for unskilled or off-season labor, it averaged 35 cents. Apparently, there is only a small advantage to scale in labor efficiency in feeding cattle. For herds of any appreciable size, the labor cost for feeding any one class of livestock is largely determined by the length of the feeding period rather than by the number of cattle fed.

The time required to feed the breeding herd, steers, and calves averaged 6.52, 4.29, and 1.15 hours per day, respectively, for all farms. Labor costs for feeding each class of livestock per day averaged $2.28 for the breeding herd, $1.50 for steers, and $0.40 for creep-feeding calves on all farms.

**Table 15.—Type, amount, and value of feed fed per farm and per animal, by size of farm, for the steer enterprise, Yazoo-Mississippi Delta, 1957.**

| | Farm size (acres) | | |
|---|---|---|---|
| Item | Under 1,000 | Over 1,000 | All farms |
| Protein supplement | | | |
| Amount — tons | 0.7 | 3.7 | 2.9 |
| Cost per farm — dollars | 49 | 256 | 201 |
| Concentrate | | | |
| Corn equivalent — bushels | 151 | 551 | 444 |
| Cost per farm — dollars | 136 | 495 | 400 |
| Roughage | | | |
| Hay — ton | .2 | 14.6 | 10.8 |
| Cost — dollar | 4 | 292 | 217 |
| Silage — ton | .... | 17.9 | 12.9 |
| Cost — dollars | —— | 72 | 52 |
| Total cost per farm — dollars | 189 | 1,115 | 870 |
| Total cost per steer — dollars | 11.12 | 30.14 | 27.19 |

**Table 16.—Estimated quantities and cost of labor used to feed cattle, by size of farm, Yazoo-Mississippi Delta, 1957.**

| | Farm size (acres) | | |
|---|---|---|---|
| Item | Under 1,000 | Over 1,000 | All farms |
| Breeding herd | | | |
| Length of feeding period (days) | 108 | 111 | 111 |
| Hours | 704 | 724 | 724 |
| Cost — dollars | 246 | 253 | 253 |
| Steers | | | |
| Length of feeding period (days) | 113 | 125 | 122 |
| Hours | 485 | 536 | 523 |
| Cost — dollars | 170 | 188 | 183 |
| Calves | | | |
| Length of feeding period (days) | 183 | 192 | 189 |
| Hours | 210 | 221 | 217 |
| Cost — dollars | 73 | 77 | 76 |
| Total cost — dollars | 489 | 519 | 511 |

**Table 17. — Summary of itemized annual direct operating costs for cattle per farm and per animal by farm size groups, Yazoo-Mississippi Delta, 1957**

| | Farm size (acres) | | | | | |
|---|---|---|---|---|---|---|
| | Under 1,000 | | Over 1,000 | | All farms | |
| Item | Cost per item | Percentage of total | Cost per item | Percentage of total | Cost per item | Percentage of total |
| | Dollars | Percent | Dollars | Percent | Dollars | Percent |
| Permanent pasture | 2,098 | 34 | 7,282 | 46 | 5,908 | 44 |
| Temporary pasture[1] | 477 | 8 | 996 | 6 | 859 | 7 |
| Feed cost | 1,887 | 31 | 4,552 | 29 | 3,847 | 29 |
| Feed labor cost | 489 | 8 | 519 | 3 | 512 | 4 |
| Specialized equipment repair cost | 43 | 1 | 93 | 1 | 80 | 1 |
| Miscellaneous cost | 980 | 16 | 1,966 | 13 | 1,715 | 13 |
| Other labor cost | 115 | 2 | 254 | 2 | 217 | 2 |
| Total per farm | 6,089 | 100 | 15,662 | 100 | 13,138 | 100 |
| Cost per head | 30.14 | ... | 38.48 | -- | 37.00 | — |

[1]Includes a portion of establishment costs when harvested for grain and all costs when grazed only

Miscellaneous labor requirements for such jobs as castrating, dehorning, spraying, and branding are presented in appendix table 4. An average of 620 hours of labor for miscellaneous jobs were used per farm. Charges for this labor amounted to $217.

**Miscellaneous Costs.** — Other relatively minor costs that contribute to the total include those for repairs to specialized equipment and such items as veterinary and medicine, spray material, salt, hauling, and fence repairs. (See appendix table 5).

An average of $80 per farm was spent on the upkeep of specialized equipment used in the beef cattle enterprise. Repairs to the water system accounted for more than 50 percent of this amount.

Costs for such items as veterinary services and medicine, spray materials, salt, hauling costs, and fencing repairs varied widely among farms. These costs averaged over $1,700 per farm and $4.83 per animal.

**Summary of Operating Costs.**—Presented in table 17 are the total annual direct operating costs per farm, by item of expense, and the proportion of total costs represented by each item. Also shown are operating costs per head for the two size groups and for all farms.

Permanent pasture and feed costs comprise the major part of the direct operating costs for each farm size group and for all farms. The importance of permanent pasture costs becomes more apparent when its effect on cost per head is noted. Despite the fact that other operating costs are the same or proportionately higher on small farms, the low cost of pasture results in a lower operating cost per head on the smaller units. This is due to more intensive use of pastures, as indicated by higher stocking rates on the small farms. On small farms, an average of 2.4 acres per mature animal was grazed, on large farms 4.1 acres, and on all farms 3.8 acres per animal (appendix table 6). Compared with recommended rates, the stocking rate on permanent pasture is low for all farms, but it is especially low on large farms, and as a result the cost of this item is relatively high.

Feed costs represented the second largest item of expense. The cow-calf enterprise used practically all of the feed as a supplement to winter pasture or other standing roughage. Feed cost per animal and size of operation showed little relationship. There was indication that where such crop residues as cotton, corn, or soybeans were grazed during the winter, both permanent pasture costs and supplemental feed requirements were reduced significantly. This reduction is discussed more fully in the section on efficient beef enterprises.

### Returns to the Beef Enterprise

Average returns per farm to the beef enterprise by class of animal are shown for each farm size group in table 18. As would be expected, calves accounted for the bulk of the returns. Steers were second in importance, and increases in inventory of the breeding herd ranked third. The smaller farms are more intensive than the larger ones and have a higher gross return per unit of land.

For a detailed breakdown of livestock inventories for all farms, see appendix tables 7, 8, and 9. Careful study and analysis of these detailed inventories give a clearer picture of the livestock operations in the area.

Total beef cattle numbers on the farms studied declined from 16,800 to 13,770, a decrease of 18 percent during 1957. Deaths accounted for 3.8 percent and sales for 14.2 percent of the total. Heavy liquidation of the beef enterprise was made to cover current operating losses incurred because of a poor cotton crop. The number of steers carried over and the number of heifer replacements fell sharply, accounting for a major part of the decrease in numbers. The calves from the previous year's crop (1956) generally transferred to the steer or replacement-heifer category were sold along with the early-born calves of the 1957 crop. Brood-cow numbers fell slightly, accounting for 4.3 percent of the decrease. Cows of poor quality, as well as old or barren cows or both, were culled and sold. Calf numbers fell by only 2.2 percent. Culling and sales of nonbearing cows held in check the number of calves lost.

The total decrease in inventory values of beef cattle was not as high as the decrease in beef cattle numbers. The value and price of all classes of beef animals increased as livestock numbers throughout the country began to rise. Favorable weather in the West increased the demand for steers and replacement heifers. Steers increased in inventory value $52.15 per head, calves $27.69 per head, bulls $44.22 per head, and cows $3.65 per head. Replacement heifers declined in value $1.60 per head. This resulted from the heavy sales of older heifers and their replacement by younger, lighter animals.

Returns to land and management were determined by subtracting interest on capital investment from returns above direct operating costs (table 19). In general, these returns are very low, indicating that, on the average, both pasture and herd management in the Delta are inadequate. Considering all costs, average returns are negative, and only on small operating units are returns to the enterprise positive.

In analyzing production costs, the im-

**Table 18.—Gross returns to the beef enterprise per farm, by size of farm and class of livestock, Yazoo-Mississippi Delta, 1957[1].**

| Class of livestock | Farm size (acres) | | |
|---|---|---|---|
| | Under 1,000 | Over 1,000 | All farms |
| | Dollars | Dollars | Dollars |
| Cows | 88 | 1,015 | 770 |
| Heifers | 317 | 1,262 | 928 |
| Bulls | | -67 | -49 |
| Steers | 1,119 | 2,364 | 2,174 |
| Calves | 6,931 | 13,063 | 11,359 |
| Total | 8,455 | 17,637 | 15,182 |

[1] Includes sales and changes in inventory values.

**Table 19.—Summarized costs and returns, beef cattle enterprises, Yazoo-Mississippi Delta, 1957.**

| Item | Farm size (acres) | | |
|---|---|---|---|
| | Under 1,000 | Over 1,000 | All farms |
| | Dollars | Dollars | Dollars |
| Annual cost per farm: | | | |
| Permanent pasture | 2,098 | 7,282 | 5,908 |
| Temporary pasture | 477 | 996 | 859 |
| Feed | 1,887 | 4,552 | 3,847 |
| Labor[1] | 604 | 773 | 729 |
| Specialized equipment repair | 43 | 93 | 80 |
| Miscellaneous | 908 | 1,966 | 1,715 |
| Total | 6,089 | 15,662 | 13,138 |
| Gross returns per farm | 8,455 | 17,637 | 15,182 |
| Returns above direct costs: | | | |
| Per farm | 2,366 | 1,975 | 2,044 |
| Per mature animal | 20.75 | 7.29 | 10.12 |
| Per acre of pasture | 8.63 | 2.17 | 2.69 |
| Interest on capital investment | 1,146 | 2,160 | 1,892 |
| Building depreciation and repair | 307 | 431 | 398 |
| Total | 1,453 | 2,591 | 2,290 |
| Returns to land and management: | | | |
| Per farm | 913 | -616 | -246 |
| Per mature animal | 8.00 | -2.67 | -1.22 |
| Per acre of pasture | 3.33 | - .67 | - .33 |

[1] Does not include certain unidentifable labor.

portance of permanent pasture and supplement feed costs cannot be overemphasized. These two items make up more than two-thirds of the total operating cost. Any practice that would reduce permanent pasture requirements or supplemental feed costs, or both, would affect returns markedly.

## Characteristics of Efficient Beef Enterprises

In an effort to ascertain the characteristics and practices followed by successful beef cattle producers, the 13 farms with the highest net returns per acre of pasture were chosen for more detailed analysis.

These farms contained an average of 2,126 acres; 1,319 acres of cropland, 462 acres of pasture, and 345 acres of woodland, homestead, etc. Only 22 percent of the total land on these farms was used for the beef enterprise compared with 33 percent for all farms. The beef enterprise consisted of 444 animals; 189 brood cows, 7 bulls, 11 heifers, 37 steers, 36 yearlings, and 164 calves.

Capital investment in the beef enterprise, excluding land, averaged $50.460. Investment in beef animals represented a higher proportion of the total (70 percent) than was true for all farms. The lower investment in buildings, specialized equipment, and permanent fencing resulted from the use of several production practices not commonly found on all farms. As each practice is discussed, its effect on investment and costs is noted.

As indicated earlier, the fact that these farms are larger than the average had no apparent effect on costs associated with the beef enterprise.

There were no discernable differences in the level of livestock health and sanitation practices carried out on these farms as compared with all farms. However, the calf drop averaged 6 percent higher on the farms studied. This was due to the prevention of deaths rather than to larger numbers of births.

Pasture cost per animal was considerably lower on these farms, averaging $19.36 for high-return farms and $29.04 for all farms. Permanent pasture used per mature animal averaged 2.2 acres as compared with 3.8 acres for all farms. Operators of nine of the high-return farms (70 percent) indicated that crop-residue grazing was a practical way to reduce both permanent pasture requirements and supplemental feed costs. This practice also lowered investment in fencing as acreages of permanent pasture were reduced.

The use of temporary pasture was somewhat more prevalent on farms with high beef yields, 3.4 compared with 1.8 acres per animal on other farms. A major part of the temporary grazing consisted of small grains that were later harvested for grain. In fact, this practice was twice as prevalent on farms having high beef yields.

Feed and feed labor costs were considerably lower on the more efficient farms. Less protein supplement and less hay were fed on these units. The feeding period was reduced from 111 to 89 days. This was due largely to the use of crop residues for the breeding herd. This practice also reduced the level of investment for harvesting, storing, and handling the feed required for the herd.

Although repairs on specialized equipment were higher on the more efficient units, because of more intensive use of the equipment, miscellaneous costs appeared to be directly related to herd size.

**Returns to the Beef Enterprise.**—On the more efficient farms, gross returns averaged $25,192. Calves accounted for $14,980, or 59 percent, and steers for $5,103, or 20 percent. Values of both cows and heifers increased, and that of bulls declined slightly.

Gross returns per calf or yearling averaged $17 per head more than for all farms. Calves weighed more at sale date and brought higher prices. Cull brood cows from these farms sold for $5.00 per head more than those from all farms.

Numbers of beef cattle on these farms declined 13 percent in 1957. Declines were noted in all classes except brood cows, which went up by 1 percent. The managerial decision to increase brood cows numbers no doubt resulted from the rel-

**Table 20.—Summary of costs and returns, selected efficient beef cattle operations, Yazoo-Mississippi Delta, 1957**

| Item | 13 farms | Average all farms |
|---|---|---|
| | Dollars | Dollars |
| Annual cost per farm: | | |
| Permanent pasture | 4,229 | 5,908 |
| Temporary pasture | 1,192 | 859 |
| Feed | 2,462 | 3,847 |
| Labor[1] | 706 | 729 |
| Specialized equipment repair | 85 | 80 |
| Miscellaneous | 2,145 | 1,715 |
| Total | 10,819 | 13,138 |
| Gross returns per farm | 25,192 | 15,182 |
| Returns above direct costs: | | |
| Per Farm | 14,373 | 2,044 |
| Per mature animal | 58.91 | 10.12 |
| Per acre of pasture | 20.27 | 2.69 |
| Interest on capital investment | 2,145 | 1,892 |
| Building depreciation and repair | 453 | 398 |
| Total | 2,598 | 2,290 |
| Returns to land and management: | | |
| Per farm | 11,775 | -246 |
| Per mature animal | 48.26 | - 1.22 |
| Per acre of pasture | 16.60 | - .33 |

[1] Does not include certain unidentifiable labor.

ative profitableness of the enterprise. Presumably, the heavier than usual marketings of other classes of animals could be associated with the poor cotton crop in 1957.

A summary of costs and returns on these farms is shown in table 20. Returns above direct operating costs and returns to land and management were considerably higher than those reported for all farms. The reduction in pasture costs and in feed and feed labor costs resulting from the use of crop residues materially affected the level of returns. Increases in gross returns were due to (1) proportionately larger calf crops, (2) heavier weights of calves at sale time, and (3) higher prices received for calves and steers.

Total costs per mature animal averaged $54.68 on the more efficient farms and $75.75 for all farms. Gross returns per mature animal averaged $103.25 for these farms as compared with $75.16 for all farms.

## General Summary

The average beef cattle farm studied contained about 2,000 acres of land. This compares with an average size for all farms of 332 acres. About 55 percent of the total acreage was in cropland, 33 percent in pasture, and 12 percent in woods and other uses. The fact that pastures occupied a third of the total land is an indication of the importance of the beef cattle enterprise on these farms. However, it also indicates that livestock is still supplementary to crop production. Cotton, soybeans, and corn occupied 66 percent of the cropland, small grains 20 percent, and the rest was devoted to forage crops and miscellaneous uses.

The average farm studied had an investment of approximately $27,000 in the beef enterprise exclusive of land. Cattle was the largest investment item, accounting for 61 percent of the total other than land. Buildings and fencing made up the bulk of the remainder.

A fall and winter calving program is widely accepted by beef producers in the area. Approximately 82 percent of the calf crop was dropped between October 1 and March 1.

The level of health and sanitation practices was somewhat higher than those found in other areas of the state. However, vaccinations for certain diseases are still below recommended standards.

Anaplasmosis and the combination of stillbirths and abortions were the major causes of death among mature animals and calves, respectively.

Pasture is the most important production factor associated with beef production. The high annual establishment and maintenance costs for pastures result from short pasture life coupled with high annual maintenance charges.

In 1957, the breeding herd received feed an average of 111 days. Hay, silage, and protein supplement account for the bulk of the feed used in the cow-calf program. Feed costs averaged $16.85 per mature animal. An additional cost of $2.28 per day was incurred in feeding the brood cow herd.

Permanent pasture and feed costs comprised the major portion of direct operating costs for each farm size group and for all farms. Compared with recommended rates, the stocking rate on permanent pasture was low on all farms and especially low on large farms. The more intensive use of pasture, as indicated by higher stocking rates, resulted in a lower operating cost per head on small farms.

Practically all of the feed was used by the cow-calf enterprise; it supplemented winter pasture or other standing roughage. When crop residues, such as cotton, corn, or soybeans, were grazed during the winter, both supplemental feed requirements and permanent pasture costs were reduced significantly.

Calf sales accounted for the greater part of all sales, with steers second in importance. Total beef numbers in the area declined 18 percent in 1957 because of liquidation of animals and reduction in herd size to cover losses resulting from a poor cotton crop.

In general, net returns were low.

An analysis of the more efficient producers in the study showed that all of these operators used coastal bermuda pasture, crop residues, or both. These farms had less land in permanent pasture and a shorter winter feeding period. Capital investment in buildings, fencing, and specialized equipment was lower than for all farms. Seventy percent of the operators of these farms indicated the use of crop-residue grazing as a means of reducing permanent pasture and supplemental feed costs. Calves produced on the 13 more efficient farms were heavier at sale time and brought more per pound than those produced on the other farms studied. These calves brought an average of $17.00 per head more than the average for those produced on all farms.

The importance of permanent pasture and supplemental feed costs cannot be overemphasized. These items made up more than 66 percent of total operating costs on all farms and 62 percent on the more efficient units.

## APPENDIX

**Table 1.—Modal pasture composition per mature animal, cow-calf enterprise, Yazoo-Mississippi Delta, 1957**

| Pasture type | Acreage per animal | Cost per unit |
|---|---|---|
| | Acres | Dollars |
| Fescue | 1.80 | 16.74 |
| Common bermuda | .60 | 5.06 |
| Johnson | .37 | 1.51 |
| Dallis | .81 | 9.06 |
| Native | .22 | 2.41 |
| Total | 3.80 | 34.79 |

**Table 2.—Labor power, and equipment cost per acre for establishment of permanent and temporary pastures, Yazoo-Mississippi Delta, 1957**

| Pasture type | Labor[1] | | Power[1] | | Equipment[1] | |
|---|---|---|---|---|---|---|
| | Hours | Dollars | Hours | Dollars | Hours | Dollars |
| Fescue | 2.83 | 1.70 | 2.53 | 2.27 | 2.53 | 1.91 |
| Common bermuda | 2.93 | 1.76 | 1.50 | 1.35 | 1.50 | 1.12 |
| Johnson | 2.71 | 1.63 | 2.52 | 2.27 | 2.52 | 1.90 |
| Dallis | 2.44 | 1.46 | 1.94 | 1.75 | 1.94 | 1.45 |
| Costal | 13.29 | 7.97 | 3.05 | 2.74 | 3.05 | [2]2.29 |
| bermuda | 3.23 | 1.94 | 1.62 | 1.46 | 1.62 | [3]1.22 |
| Fescue clover | 2.18 | 1.31 | 1.92 | 1.73 | 1.92 | 1.44 |
| Fescue wild winter peas | 2.18 | 1.31 | 1.92 | 1.73 | 1.92 | 1.44 |
| Small grains[4] | 2.95 | 1.77 | 2.32 | 2.09 | 2.32 | 1.74 |
| Sudan | 2.17 | 1.30 | 2.10 | 1.89 | 2.10 | 1.57 |
| Millet | 2.20 | 1.32 | 2.10 | 1.89 | 2.10 | 1.57 |
| Lespedeza | 1.50 | .90 | .33 | .30 | .33 | .25 |
| Crop residue | 1.60 | [5].56 | .40 | .34 | .40 | .26 |

[1] Wage rate $0.60 per hour, power rate $0.90 per hour, equipment rate $0.75 per hour.

[2] Hand sprigged.

[3] Machine sprigged.

[4] Includes oats, rye grass, and wheat alone and in combinations.

[5] Off-season labor at $0.35 per hour.

Table 3.—Labor, power, and equipment cost per acre for maintenance of permanent pasture, Yazoo-Mississippi Delta, 1957

| Pasture type | Labor | | Power | | Equipment | |
|---|---|---|---|---|---|---|
| | Hours | Dollars | Hours | Dollars | Hours | Dollars |
| Fescue | 1.28 | 0.77 | 0.84 | 0.76 | 0.84 | 0.63 |
| Common bermuda | 1.37 | .82 | 1.08 | .98 | 1.08 | .81 |
| Johnson | 1.04 | .62 | 1.04 | .94 | 1.04 | .78 |
| Dallis | 1.13 | .68 | .96 | .86 | .96 | .72 |
| Coastal bermuda[1] | 1.53 | .92 | 1.32 | 1.19 | 1.32 | .99 |
| Fescue clover | .88 | .53 | .58 | .52 | .58 | .44 |
| Fescue wild winter peas | .88 | .53 | .58 | .52 | .58 | .44 |

[1] Same for hand and machine sprigged.

Table 4.—Other labor costs, by size of farm, Yazoo-Mississippi Delta, 1957.

| Farm size | Hours per farm[1] | Cost per farm[2] |
|---|---|---|
| Acres | Hours | Dollars |
| Under 1,000 | 328 | 115 |
| Over 1,000 | 725 | 254 |
| All farms | 620 | 217 |

[1] Includes time required for treating sick and injured animals castrating, dehorning, spraying, and herd checking.

[2] Prevailing wage rate in area $0.35 per hour.

Table 5.—Miscellaneous expenses, beef cattle enterprise, Yazoo-Mississippi Delta, 1957.

| Item | Average cost per head |
|---|---|
| Veterinary and medicine | 1.16 |
| Spray material | .19 |
| Feed grinding | .06 |
| Salt and minerals | .60 |
| Marketing charge | .52 |
| Taxes | .58 |
| Insurance on buildings | .21 |
| Fence repair | .66 |
| Truck | .66 |
| Automobile | .19 |
| Total | 4.83 |

Table 6.—Stocking rate on permanent pasture by size groups, Yazoo-Mississippi Delta, 1957

| Item | Farm size (acres) | | |
|---|---|---|---|
| | Under 1,000 | Over 1,000 | All farms |
| Number animals[1] | 97 | 194 | 1.70 |
| Acreage of permanent pasture | 229 | 795 | 645 |
| Acreage of permanent pasture per animal | 2.4 | 4.1 | 3.8 |

[1] Mature animals in the breeding herd. Steers did not utilize permanent pasture.

Table 7.—Beef cattle inventory, farms under 1,000 acres, Yazoo-Mississippi Delta, 1957.

| Item | Cows | Heifers | Bulls | Steers | Cavles |
|---|---|---|---|---|---|
| Start | | | | | |
| Number | 78.1 | 5.3 | 3.7 | 17.6 | 33.6 |
| Value | 13,125 | 633 | 1,856 | 2,188 | 1,562 |
| Purchase | | | | | |
| Number | 11.8 | 1.0 | .4 | .... | 1.4 |
| Value | 1,811 | 172 | 200 | .. | 56 |
| Born | | | | | |
| Number | .. | | . | .. | 50.7 |
| Sale | | | | | |
| Number | 19.0 | ---- | 0.3 | 15.6 | 60.3 |
| Value | 2,293 | ------ | 105 | 2,498 | 6,756 |
| In transfer | | | | | |
| Number | 5.9 | 2.2 | ---- | ---- | ------ |
| Value | 900 | 194 | | | |
| Out transfer[1] | | | | | |
| Number | ---- | 5.9 | ... | —— | 2.2 |
| Value | .... | 900 | ... | — | 194 |
| Death | | | | | |
| Number | 1.8 | .1 | ...... | .3 | 3.2 |
| Value | 254 | 11 | ... | 32 | . |
| End | | | | | |
| Number | 75.0 | 2.5 | 3.8 | 1.7 | 20.0 |
| Value | 12,541 | 222 | 1,950 | 809 | 1,599 |

[1] Same as sales.

Table 8.—Beef cattle inventory, farms over 1,000 acres, Yazoo-Mississippi Delta, 1957

| Item | Cows | Heifers | Bulls | Steers | Cavles |
|---|---|---|---|---|---|
| Number | 162 | 21 | 7 | 30 | 66 |
| Value | 24,264 | 2,204 | 2,911 | 3,092 | 3,588 |
| Purchase | | | | | |
| Number | 15 | 3 | 1 | 3 | 8 |
| Value | 2,387 | 284 | 471 | 313 | 339 |
| Born | | | | | |
| Number | -------- | ---- | ---- | ---- | 101 |
| Sales | | | | | |
| Number | 37 | 5 | 2 | 29 | 95 |
| Value | 5,218 | 479 | 571 | 5,149 | 10,724 |
| In transfer | | | | | |
| Number | 13 | 8 | ---- | 3 | . |
| Value | 1,638 | 846 | ---- | 281 | — |
| Out transfer[1] | | | | | |
| Number | -------- | 13 | ---- | ---- | 11 |
| Value | -------- | 1,314 | ---- | ---- | 1,104 |
| Death | | | | | |
| Number | 4 | [2] . | [3] ---- | [4] ---- | 5 |
| Value | 597 | 22 | 114 | 20 | |
| End | | | | | |
| Number | 149 | 14 | 6 | 7 | 64 |
| Value | 22,448 | 1,596 | 2,744 | 616 | 5,136 |

[1] Same as sales.

[2] 0.20 animals per farm.

[3] 0.30 animals per farm.

[4] 0.24 animals per farm.

**Table 9.—Beef cattle inventory, all farms, Yazoo-Mississippi Delta, 1957.**

| Item | Cows | Heifers | Bulls | Steers | Calves | Total |
|---|---|---|---|---|---|---|
| Start | | | | | | |
| Number | 9,510 | 1,170 | 422 | 1,798 | 3,900 | 16,800 |
| Value | 1,449,462 | 125,201 | 178,950 | 193,969 | 207,538 | 2,155,120 |
| Purchase | | | | | | |
| Number | 930 | 184 | 61 | 162 | 432 | 1,769 |
| Value | 151,962 | 17,294 | 27,175 | 15,643 | 17,930 | 230,004 |
| Born | | | | | | |
| Number | | | | | 5,980 | |
| Sale | | | | | | |
| Number | 2,216 | 247 | 99 | 1,733 | 5,853 | 10,148 |
| Value | 302,240 | 23,974 | 30,465 | 302,413 | 653,605 | 1,312,697 |
| In transfer | | | | | | |
| Number | 764 | 463 | | 135 | | 1,362 |
| Value | 98,100 | 45,800 | | 14,060 | | 157,960 |
| Out transfer[2] | | | | | | |
| Number | | 764 | | | 598 | 1,362 |
| Value | | 97,800 | | | 58,690 | 156,490 |
| Death | | | | | | |
| Number | 255 | 11 | 16 | 18 | [1]331 | 631 |
| Value | 34,427 | 1,325 | 5,709 | 1,586 | — | 43,047 |
| End | | | | | | |
| Number | 8,733 | 795 | 368 | 344 | 3,530 | 13,770 |
| Value | 1,362,857 | 83,802 | 172,325 | 55,049 | 285,575 | 1,959,608 |

[1] Does not include stillbirths (180).

[2] Same as sales.

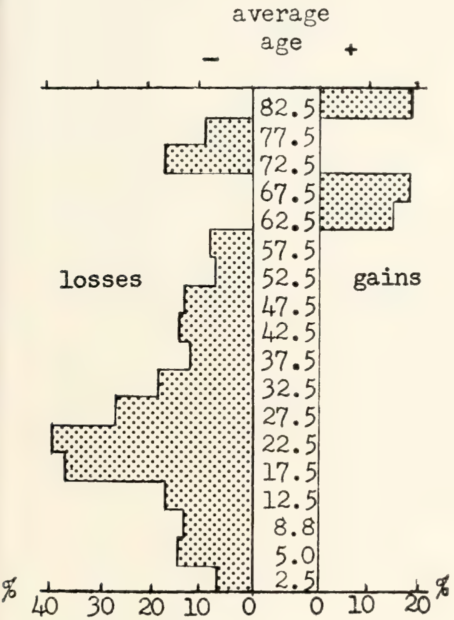
**Table 10.—Feed and permanent pasture costs per head resulting from the utilization of crop residues for the cow-calf enterprise by farm size group, Yazoo-Mississippi Delta, 1957.**

| | Farm (size acres) | | | | | |
|---|---|---|---|---|---|---|
| | Under 1,000 | | Over 1,000 | | All farms | |
| Item | Crop residues | Permanent pasture | Crop residues | Permanent pasture | Crop residues | Permanent pasture |
| Number of farms | 7 | 11 | 20 | [1]27 | 27 | [1]38 |
| Acres crop residues per farm | 287 | | 452 | | 409 | |
| Acres permanent pasture per farm | 316 | 173 | 695 | 966 | 597 | 753 |
| Number animals per farm | 283 | 141 | 379 | 309 | 354 | 264 |
| Acres permanent pasture per animal | 1.1 | 1.2 | 1.8 | 3.1 | 1.7 | 2.9 |
| Days fed supplemental feed: | | | | | | |
| Breeding herd | 84 | 123 | 105 | 117 | 100 | 118 |
| Calves | 212 | 174 | 100 | 159 | 129 | 163 |
| Cost of feed fed | 1,586 | 2,164 | 3,082 | 4,559 | 3,694 | 3,916 |
| Feed cost per head | 5.60 | 15.32 | 8.13 | 14.75 | 7.61 | 14.83 |
| Pasture cost per head | 10.08 | 10.99 | 16.49 | 28.40 | 15.57 | 26.56 |
| Total specified cost per head | 15.68 | 26.31 | 24.62 | 43.15 | 23.18 | 41.39 |

[1] Three farms eliminated from analysis because of abnormal feeding practices.

BULLETIN 632 DECEMBER 1961

# Net Migration In Mississippi



# 1950 To 1960

**Ellen S. Bryant**
**and**
**G. L. Wilber**

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# NET MIGRATION IN MISSISSIPPI, 1950 TO 1960

By ELLEN S. BRYANT and G. L. WILBER

Mississippi lost more than 400,000 persons as a result of migration during the 1950's. This loss of population through migration — large enough to have populated three cities about the size of Jackson — has turned a normally growing state population into a gradually declining one.

If Mississippi had experienced no migration losses for the decade, its population would have increased by about 20 percent to over 2.6 million persons. Instead it diminished by 773 persons, somewhat less than one percent.

Various segments of the population were affected differently by migration. The younger ages were most heavily hit with 80 percent of the loss occurring among those under 35 years of age. Both white and nonwhite populations lost through migration, but nonwhites accounted for 75 percent of the total outmovement. Migration losses among nonwhites was, in fact, so high it decreased this segment of the population by 7 percent, or 69,687 persons. For the white population migration losses were not sufficient to draw off all the natural increase and the state accrued a net of 68,914, or 5.8 percent of white persons. Rural-urban differences were also outstanding. Migration depleted the rural areas by over half a million residents, but channelled about 80,000 new residents into the state's urban areas.

### Components of Change

Three components — births, deaths, and net migration — determine population change. The first two combine to yield natural increase and are the only two ultimate factors in worldwide population growth. Migration is the flow of people between political areas and consists of both movements into and out of a region. Net migration is the difference between in and out migration. Thus Mississippi's net migration losses do not mean that there has been no influx of persons from other areas into the state, but only that persons leaving outnumbered those entering. However, as seen above, experiencing a net loss of persons from migration does not necessarily result in a net population decrease in an area unless the number leaving is greater than the natural increase.

Table 1 shows the three components of population change for Mississippi and its economic areas. The Gulf Coast and Hinds County are the only two areas within the state to show net in-migration

Table 1.—Components of population change for the State and its economic areas, Mississippi, 1950-1960

| Area | White | | | Nonwhite | | |
|---|---|---|---|---|---|---|
| | Natural increase | Net migration | Net change | Natural increase | Net migration | Net change |
| The State | 177,383 | —108,469 | 68,914 | 246,001 | —315,688 | —69,687 |
| Economic Area | | | | | | |
| 1 | 22,870 | — 22,967 | — 97 | 72,363 | —114,459 | —42,096 |
| 2 | 10,137 | — 15,926 | — 5,789 | 41,648 | — 59,245 | —17,597 |
| 3 | 15,135 | — 14,819 | 316 | 26,907 | — 32,290 | — 5,383 |
| 4 | 15,734 | — 30,496 | —14.762 | 7,073 | — 10,259 | — 3,186 |
| 5 | 14,835 | — 656 | 14,179 | 20,254 | — 28,358 | — 8,104 |
| 6 | 38,120 | — 56,396 | — 18.276 | 46,672 | — 64,726 | —18,054 |
| 7 | 14,454 | — 6,576 | 7,878 | 6,622 | — 2,990 | 3,632 |
| 8 | 29,148 | 22,359 | 51,507 | 6.780 | 3,398 | 10,178 |
| A | 16,950 | 17,008 | 33,958 | 17,682 | — 6,759 | 10,923 |

Data Source: Mississippi State Board of Health and U S. Bureau of the Census.

**Table 2.—Total net migration in the South, 1940 to 1960.**

| | 1950-1960 | 1940-1950 |
|---|---|---|
| | % | % |
| Mississippi | —19.9 | —19.8 |
| Arkansas | —22.7 | —21.3 |
| West Virginia | —22.3 | —12.4 |
| The South | — 3.0 | — 5.1 |
| East South Central | —12.8 | —11.9 |
| West South Central | — 4.0 | — 7.1 |
| South Atlantic | 3.1 | 0.4 |

Source: Bureau of the Census, **Current Population Reports,** Series P-25, No. 227, "Population Estimates," April 26, 1961.

(although individual counties within other areas did). Mississippi and five of its economic areas experienced total net gains of white persons and three economic areas had total net increments of nonwhites. Gaining areas are the coast, adjoining coastal plains, Hinds County, and the industrializing northeastern section of the state.

### Migration Trends

Population mobility is an American characteristic. Throughout the history of the nation people have responded to needed adjustments in a changing economy by moving into new or developing areas. One of the most significant migratory flows in contemporary times is the exodus of people from the agricultural South into the heavily industrialized cities of the North and West.

While migration losses are generalized throughout much of the South, there are significant variations in the degree, direction and trend of its population movements. For instance, the South Atlantic area gained migrants during the last twenty years while the West South Central, though continuing to have a net loss of movers, reduced its rate of net loss (See Table 2). Mississippi, however, has continued over the past two decades to have one of the highest rates of out-migration in the South. Arkansas and West Virginia are the only states in the South and in the nation which have exceeded Mississippi's migration loss rates. Thus, while the Southern population exodus is a generalized phenomena, it is particularly acute in Mississippi.

The out-movement of its people has been characteristic of Mississippi since 1870 and a special concern to the state's economic planners since the depression days of the 1930's. Population losses can curtail industrial and economic expansion, increase tax burdens, and stall the development of educational plants and governmental functions. These contractions of activity can be especially acute if losses are concentrated among people in their productive ages. Figure 1 shows migration trends by race for the state from the 1870 to 1880 intercensal period to that of 1940 to 1950. The solid line on the chart indicates three peaks of out-migration for white Mississippians. The first and highest upsurge in the out-movement came in the 1880's, an era when agricultural credit was tight and the nation was developing its diversified metal industries. Bicycles, trolley cars, cameras, typewriters, fountain pens, etc., came into use for the first time in the 1880's.[1] The second, somewhat shallower, peak occurred during the World War I decade and the last and lowest rise developed during the expanding war economy of the 1940's and has continued at a high rate ever since. It is obvious that Mississippi's population movements are not related solely to her own economic situation but are very responsive to economic activities in the rest of the nation.

Nonwhite out-migration, represented by a broken line of the chart, did not gather

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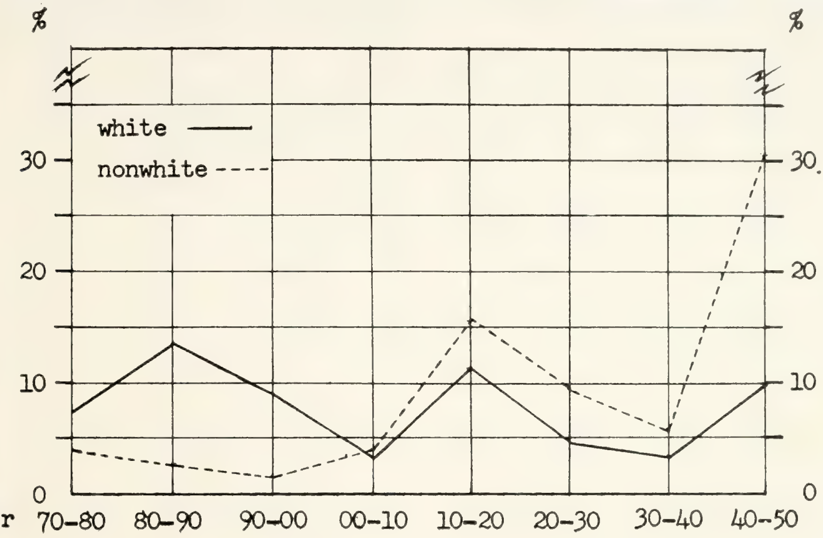
[1] Hacker, Louis M., Benjamin B. Kendrick, **The United States Since 1865.** New York: F. S. Crofts and Co., 1949, pp. 188-206.

**Fig. 1. White and Nonwhite Net Migration Losses, Mississippi 1870 to 1950.**



Data Source: Lee, Everett S., et al, Population Redistribution and Economic Growth, United States, 1870-1950, Vol. I, Methodological Considerations and Reference Tables. Philadelphia: The American Philosophical Society, 1957.

much momentum until 1900, but since then it has shown trends which are similar to but which far exceed the white outmovement. By the 1940's migration losses ran three nonwhites for every white Mississippian.

## Method

State and national statistics on internal migration are difficult to obtain. Except for a very limited amount of census data on change of residence, most migration data must be obtained indirectly and treated mathematically to obtain an estimate or approximation of net moves. Because of the variety of choice in both data and method, estimates of migration may vary considerably. The estimates of Mississippi migration between 1950 and 1960 prepared for this report were derived by a residual method. To the state's 1950 population, births during the decade were added and deaths subtracted to obtain an estimate residual 1960 population — or an estimate of what Mississippi's 1960 population would have been had there been no migration. The estimated residual population was subtracted from the enumerated 1960 population; the difference is the estimate of net migration.

Rates of migration were computed by dividing net migration by the estimated residual population. The estimated residual 1960 population, rather than the initial 1950 population, was selected as the percentage base for migration so as to include persons born during the decade as potential migrants. This method gives a slightly lower but more realistic migration rate than using the 1950 population as a base. Rates computed by the Bureau of the Census, some of which are used to establish trends in this report, were computed on a 1950 population base, and are generally higher than those arrived at by this department.

The age-specific migration rates required additional computations. In subtracting the decade's deaths from the 1950 age cohorts, it was necessary to determine the age in 1950 of persons dying. Since mortality figures are given as of age at death, it was necessary to allocate the deaths to their younger age categories before a residual population estimate and the age-specific migration estimate could be computed. The age-specific migration rates thus estabilshed are very useful in establishing trends for different age levels. However the rates apply to age cohorts, or groups which advance over time from one age level to another, rather than age intervals. For each 5-year cohort in Table 3, migration occurred somewhere within the ten-year period during which its members advanced from the 1950 to 1960 age levels. Within each cohort there is a wide range of possible migration ages. For instance, migration may have occurred at any time between the tenth and twenty-fifth birthdays among cohorts aged 10-14 in 1950 and 20-24 in 1960. In most cases an even distribution of migration over the age range can be assumed, but clustering must be assumed for the teens and some advanced ages.

## Age and Sex Differences

Migrants from Mississippi came chiefly from the young age groups. Roughly 80 percent were under 35 years of age; 54 percent averaged between the ages of 17 and 40; and, nearly 40 percent were in the age categories of high school and college graduates. The diagram on the cover shows age profile of Mississippi's net migration. For simplicity average cohort ages have been substituted for the cumbersome cohort age spans. The bulge in the late teens and early twenties can be readily seen. It represents a large proportion of Mississippi's ten-year crop of new additions to the labor force. With their removal the state lost not only the investment in their education, but also the economic wealth their many years of productivity would have created.

Toward middle age there is a rather proportional decrease in migrants. As retirement age approaches the direction of migration reverses and there is a net increase of older persons in the state. This in-movement of persons at retirement ages is evident among both races and both sexes, although it is not as extensive for white persons as for nonwhites. Between 65 and 75 there is again evidence of a small net out-migration from the state but after 75 the net flow reverses for a second time.

The increments in population occurring at about retirement age have several possible explanations. Errors in reporting age, whether deliberate or unintentional, are most likely to be made among the older population. Such inaccuracies can distort observed population age trends. However, the fact that net migration gains among all four race-sex groups recurs at the age of 75 gives strong argument that there is actually a net movement of older persons into Mississippi. Whether this influx of the aged consists of those seeking a comfortable environment for their old age, or mainly of Mississippians who are returning home after spending their economically productive years in another state is, of course, unknown. An area or county breakdown of age-specific migration might indicate which type of migration has been taking place. If increments of the aged were found to be concentrated in the warm coastal counties, one might conclude that the influx was part of the national retirement migration pattern.

**Age Trends of White Migrants:** The general age trends explored above apply to all four race-sex groups. However, as might be expected from the extreme differences between the races in rates of total net migration, there are observable differences in the age patterns for white and nonwhite migrants. There are, in fact,

**Table 3.—Mississippi net migration for five year age cohorts, 1950 to 1960, by Race and Sex.**

| Cohort age groups | | White | | | | Nonwhite | | | |
|---|---|---|---|---|---|---|---|---|---|
| Age in 1950 | Age in 1960 | Male | | Female | | Male | | Female | |
| | | Number | %* | Number | %* | Number | %* | Number | %* |
| Births 1955-60 | Under 5 | — 3,342 | — 4.7 | — 3,010 | — 4.5 | — 9,810 | —11.9 | — 5,060 | — 6.5 |
| Births 1950-55 | 5-9 | — 1,926 | — 2.9 | — 1,134 | — 1.8 | —21,479 | —24.3 | —17,679 | —23.8 |
| Under 5 | 10-14 | — 4,045 | — 6.0 | — 4,589 | — 7.0 | —13,705 | —18.8 | —15,047 | —20.6 |
| 5-9 | 15-19 | — 2,110 | — 3.6 | — 5,468 | —9.7 | —16,281 | —26.6 | —16,816 | —27.6 |
| 10-14 | 20-24 | —12,352 | —22.9 | —11,528 | —22.2 | —30,064 | —54.7 | —26,534 | —48.7 |
| 15-19 | 25-29 | —14,084 | —27.5 | —10,833 | —22.0 | —27,415 | —60.8 | —24,271 | —51.8 |
| 20-24 | 30-34 | — 7,164 | —15.5 | — 5,585 | —11.9 | —16,133 | —48.9 | —15,893 | —40.7 |
| 25-29 | 35-39 | — 4,077 | — 9.3 | — 3,658 | — 8.1 | — 9,818 | —36.5 | — 9,455 | —29.2 |
| 30-34 | 40-44 | — 2,264 | — 5.7 | — 2,287 | — 5.5 | — 5,255 | —22.7 | — 5,282 | —18.8 |
| 35-39 | 45-49 | — 2,316 | — 5.8 | — 3,494 | — 8.3 | — 5,375 | —21.1 | — 7,440 | —24.1 |
| 40-44 | 50-54 | — 2,328 | — 6.3 | — 2,681 | — 7.0 | — 4,497 | —19.5 | — 5,693 | —21.4 |
| 45-49 | 55-59 | — 414 | — 1.4 | — 922 | — 2.9 | — 3,002 | —14.8 | — 3,798 | —16.8 |
| 50-54 | 60-64 | — 704 | — 3.0 | — 856 | — 3.3 | — 2,780 | —17.8 | — 2,572 | —14.7 |
| 55-59 | 65-69 | + 1,422 | + 7.7 | + 1,357 | + 6.4 | + 2,764 | +23.8 | + 4,200 | +36.7 |
| 60-64 | 70-74 | + 1,448 | +10.5 | + 1,238 | + 7.6 | + 2,773 | +41.9 | + 2,911 | +41.1 |
| 65-69 | 75-79 | — 268 | — 2.6 | — 1,022 | — 7.7 | — 2.487 | —27.0 | — 3,728 | —34.8 |
| 70-74 | 80-84 | — 3 | — 0.1 | — 90 | — 1.3 | — 873 | —22.7 | — 843 | —20.8 |
| 75+ | 85+ | + 386 | +16.6 | + 746 | +23.5 | + 408 | +21.6 | + 355 | +15.4 |
| Totals | | —54,141 | — 8.0 | —53,816 | — 7.9 | —163,029 | —26.9 | —152,645 | —24.2 |

*Percents are of the number migrating from each age cohort. They are not a percentage distribution of all migrants and therefore do not add

Data Sources: Mississippi State Board of Health; U. S. Bureau of the Census; and U. S. Department of Health, Education and Welfare.

more variations in age-specific migration rates between the races than between the sexes. Table 3 catalogues net migration and migration rates for five-year age cohorts of the four race-sex groups during the decade. Both the 1950 and 1960 ages of each five-year cohort are given. The average age for each cohort would fall at the midpoint between the outside limits of each two age categories.

The youngest white cohorts show a small peak in outmigration rates. In the next older cohort, migration drops to two or three percent, a rate that is not reached again till approaching retirement age. The indication is that white families who migrate do so while their children are in infancy and that once their youngsters are of school age there is very little long distance family moving. In the teen ages the rates rise abruptly, earlier for the girls and somewhat erratically for the boys. The tendency for girls to marry at younger ages and the lack of paying jobs for young women in the rural areas probably account for the earlier increase in migration rates for white females. However, during the ages of heaviest migration and continuing to about age 40, losses among the male cohorts are higher than for females.

As observed before, the two cohorts of both sexes who were between 10 and 19 in 1950 and between 20 and 29 in 1960 had the highest rates of loss. About 25 percent of white persons in these ages left the state during the decade. It is not unreasonable to assume that the migration of these two cohorts clustered at 18 and 22 years, and that 25 percent is a rough approximation of the percentage of each high school graduating class which leaves the state in quest of better economic opportunities. Some of the high school alumni will undoubtedly delay migration until completion of college work, but either way, Mississippi is probably losing the total productivity of about twenty-five percent of the white youth it is paying to educate.[2]

After the migration peaks in the late teens and early twenties, out-movement again begins to fall off. In fact, once past the age of twenty, the chances that a white person will migrate have dropped to about half of what they were in his teen years. As age increases the liklihood of migration continues to drop, sharply at first, and then gradually leveling off to three percent or less for cohorts passing 55 years. At advanced ages, outmovement has practically ceased and there is instead the above mentioned excess of persons above the number of survivors from the preceding census. While the rate of in-movement is pronounced, it is much less extreme for whites than for non-whites.

**Nonwhite Migrant Age Trends:** Nonwhite net migration losses were considerably larger than that for whites, and the age range of heavy outmigration was much wider. For every age cohort (except 1) under 65 years of ages in 1960, the nonwhite net outmigration rate was at least double that of the white population. No fewer than 10 of the 18 nonwhite cohorts showed net male and female outmigration rates of 20 percent or more. Among those groups approaching retirement age, nonwhite losses were 14.7 percent of females and 17.8 of males. White cohort losses had dropped below this level before the age of 35. Only about 60 percent of nonwhite migration occurred among those between 20 and 55 in 1960, ages which can be considered the most productive years of life, as compared with nearly 80 percent of white movement. There were net migration gains for all those aged 65-74 years in 1960, but non-white migration gains were several times higher than white increases.

Nonwhite males, aged 25 through 29 in 1960, were the most migratory cohort in the state's population, contributing 60.8 percent of their numbers to the out-of-state exodus. Nonwhite females of the same age lost 51.8 percent. However, while nonwhite losses like the white losses, seem to be heaviest in the later teens and early twenties, it is tenuous to assume at this time that they are in any way related to the educational programs of nonwhite youth.

There are two main reasons for this. First, the proportions of nonwhite youth finishing high school during the 1950's were generally low; and second, the high rates of nonwhite out-movement in the ages which precede and follow the upsurge in the age groups which would have contained the high school graduates, suggest that changing non-white migration rates are more related to physical maturation than the compleion of educational programs.

Much of the migration of nonwhite youths under 15 may be related to family moves. The high rates for nonwhites at dependency ages suggest the existence of basic differences in the family migration patterns of whites and nonwhites. Economic instability probably extends farther into the family cycle of the average nonwhites, or it may be that the Negro migrant family needs a broader definition than that of a married pair plus offspring, which is the typical American concept of family.

The nonwhite in-migration rates at retirement ages are also noticeably larger than white rates. A sizeable proportion of the nonwhite gains may be the result of incorrect reporting. It has been estimated, for example, that about 18 percent of nonwhites reported themselves as older than their actual ages in 1950. Their purpose was to make census records conform with records on their prematurely obtained old age benefits. If the same percents apply in 1960, nonwhite in-migration at retirement ages would be somewhat less than 20 percent, a proportion which is still higher than for white persons.

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[2] One study of migration of white high school graduates from a small town in Mississippi found 75 percent left their home community over a six year period. See; Pedersen, Harald A., and Willis Joe Robertson, MIGRATION OF HIGH SCHOOL GRADUATES FROM A MISSISSIPPI COMMUNITY. State College: Tre Social Science Research Center Mississippi State University, November, 1954.

Nonwhite males have higher rates of loss than nonwhite women during the most migratory ages. The few exceptions to higher rate losses for males are slight and occur under 20 and after forty years of age.

### Rural Losses and Urban Gains

Not all areas of Mississippi suffered out-migration of its population and loss of large proportions of its young adults. The state's urban population added allmost 80,000 migrating individuals besides retaining their natural increase. Thus net migration losses were confined entirely to the state's rural population. This, of course, does not mean that some urban areas did not diminish while others had gains. The changes shown in this report are net migration changes, and therefore may conceal many counter currents of migration, including an undetermined amount of in-migration from other states.

A staggering 95 percent of the 79,545 net migration into Mississippi cities were white. Nonwhites accounted for only five percent. Evidently there has been very little rural-urban redistribution of the nonwhite population in Mississippi. If there is increased employment of rural nonwhites in the state's towns and cities, these workers must be retaining their rural residence. Nonwhite residence change out of rural areas has evidently been almost entirely confined to long distance migration.

The absence of sizeable influxes of nonwhites into urban centers does not by itself mean lack of growth of the state's nonwhite urban population. Urban nonwhites had a higher rate of natural increase than any other group in the state. Consequently their rate of net increment was 26.7 percent, nearly two-thirds that of the white population.

### County and Economic Area Migration

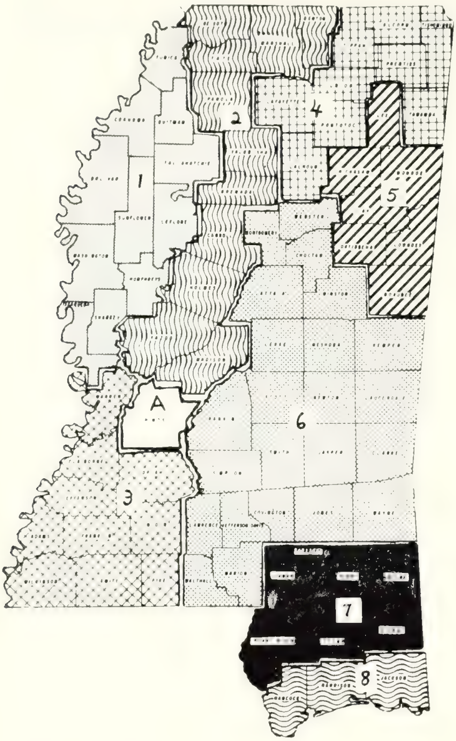
How then did migration affect Mississippi's population at local levels? Table 5 lists components of population change by race for counties and state economic areas. Only ten Mississippi counties experienced a net in-migration of whites, although 27 counties had net increases in the total number of white residents during the 50's. The ten counties which added white migrants all contain sizeable urban developments. Furthermore those counties with the largest inmovement had the highest rates of growth. Washington (Greenville), Lowndes (Columbus), Rankin (outskirts of Jackson) Hinds (Jackson), Jackson (Pascagoula, Moss Point, and Ocean Springs), and Harrison (Gulfport and Biloxi) had inmigration rates ranging from 10 to 40 percent and growth rates of about 40 to 80 percent among their white populations. Other counties, with white growth rates of 20 percent or under, had very little

**Table 4.—Urban and rural migration by race, Mississippi, 1950-1960.**

| Area | Population 1950 | Population 1960 | Net migration Number | Net migration Percent | Natural increase Percent | Net change Percent |
|---|---|---|---|---|---|---|
| State | 2,178,914 | 2,178,141 | —424,158 | —16.3 | 19.4 | —0.03 |
| White | 1,188,632 | 1,257,546 | —108,470 | — 7.9 | 14.9 | 5.8 |
| Nonwhite | 990,282 | 920,595 | —315,688 | —25.5 | 24.8 | 7.0 |
| Urban | 607,162 | 820,805 | 79,545 | 10.7 | 22.1 | 35.2 |
| White | 374,320 | 525,853 | 75,476 | 16.8 | 20.3 | 40.5 |
| Nonwhite | 232,842 | 294,952 | 4,069 | 1.4 | 24.9 | 26.7 |
| Rural | 1,571,752 | 1,357,336 | —503,703 | —27.1 | 18.4 | —13.6 |
| White | 814,312 | 731,693 | —183,946 | —20.1 | 12.4 | —10.1 |
| Nonwhite | 757,440 | 625,643 | —319,757 | —33.8 | 24.8 | —17.4 |

Data Source: Same as Table 1.

**Figure 2. Economic Areas of Mississippi**



or no inmigration.

Only three Mississippi counties showed an actual net inmigration of nonwhites. These were coastal Jackson and Harrison and nearby Stone Counties. Mississippi's Gulf Coast and adjoining coastal plains counties (Economic Areas 7 and 8) were the only extensive areas in the state showing general and sizeable net increases in nonwhite populations since 1950. In this area there are even a few instances of nonwhite increments exceeding white increases. Even so, most of the coastal increases among nonwhites were the result of the retention of natural increases rather than actual in-movement. All of the counties in the coastal area have had and continue to have below average percentages of nonwhites, ranging about 12 percent in George to nearly 29 percent in Forrest. In the interior of the state only Adams County (Natchez) and Hinds County (Jackson) retained enough of their natural increases to have a sizeable growth in nonwhite population, and both of these counties experienced some loss of nonwhites through migration.

## Implications

Mississippi's population was in a state of rapid flux during the 1950's, although it remained nearly static in total numbers. Changes in distribution and composition took place in most areas of the state. These were the result both of migration and varying rates of natural increase. Some counties and economic areas have grown and others have lost population. City populations increased while rural totals decreased. A disproportionately large segment of dependent age persons resulted from the combined factors of heavy out-movement of persons in their productive years, in-movement of retirement age persons, and the high rate of natural increase. Also significant has been the increase in ratio of white to nonwhite citizens.

Most of the migration, both within and beyond the state's borders, was an expression of a vigorous population's efforts to adjust to a changing economy. The streamlining of farming enterprises plus the expanding of industries in the cities have spurred thousands of Mississippi's surplus rural youth to seek new homes and new occupations in the nation's burgeoning urban areas. Many of the migrating white persons found new residences in Mississippi's own growing cities, but nearly all the nonwhite migrants moved to regions outside the state.

Migration, with its concurrent changes in the composition of an area's population, is sometimes viewed with alarm; sometimes it is shrugged off as inevitable and occasionally it is accepted as desirable. Probably all three attitudes can be justified. If young people are to establish new homes and enjoy a high living standard, they must have adequate incomes. When the home community cannot provide the source for new incomes, migration inevitably becomes an economic and social necessity and can be considered a desirable method of balancing available workers to available jobs in a progressive economy.

On the other hand the loss of investment and manpower ensuing from outmigration is a heavy financial incumbrance to residents of the state. The financial loss to Mississippi from migration during the 1950's was enormous. For instance, if the cost of rearing and educating a child in Mississippi to age 18 is assumed to be $12 thousand[3] per white child and $5 thousand per nonwhite child, the lost investment in migrating youth to Mississippi people can be estimated at somewhat over $1 billion during the decade. In addition there are partial investment losses in those who migrated before reaching maturity, or after about 23 years of age. The state's financial loss in productive potential of its migrants is even higher. If we assume conservatively that each white migrant would have earned $2400 a year and each nonwhite $1200 a year had they remained in Mississippi, migration is costing the state an additional $600 million a year in earned wealth. When this figure is multiplied by the number of remaining working years in each migrant's lifetime, the figure becomes astronomical. If investment and production losses are added together, Mississippi's migration loss during the 1950's cost the state an average of $700 million a year.

Thus Mississippi's migration exodus carried an expensive price tag, although at the present time population outmovement is necessary to balance population with economic resources. Industrial expansion in the state has thus far not kept pace with the natural increase in inhabitants. However, in future years Mississippi's economy may expand to the point where it can efficiently employ all her maturing youth. At such a time outmigration should no longer characterize Mississippi's people.

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[3] Derived from data in U. S. Bureau of the Census, STATISTICAL ABSTRACT OF THE UNITED STATES, 1958, Washington: U. S. Government Printing Office, 1958; and Pedersen, Harald A. MIGRATION FROM MISSISSIPPI, Information Sheet 536, State College: Mississippi State University Agricultural Experiment Station, May 1956.

Table 5.—Components of Population Change, Mississippi Counties and State Economic Areas, 1950 to 1960.

| Area | White | | | | | Nonwhite | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1960 Population | Net migration | | Natural increase | Net change | 1960 Population | Net migration | | Natural increase | Net change |
| | Number | Number | Percent* | Percent* | Percent* | Number | Number | Percent* | Percent* | Percent* |
| State | 1,257,546 | —108,469 | — 7.9 | 14.9 | 5.8 | 920,595 | —315,688 | —25.5 | 24.8 | — 7.0 |
| Economic Area I | 128,800 | — 22,967 | —15.1 | 17.7 | — 0.1 | 238,739 | —114,459 | —32.4 | 25.8 | —15.0 |
| Bolivar | 17,521 | — 5,532 | —24.0 | 16.0 | —11.8 | 36,943 | — 17,152 | —31.7 | 25.4 | —14.4 |
| Coahoma | 14,630 | — 1,485 | — 9.2 | 17.6 | 6.8 | 31,582 | — 13,151 | —29.4 | 25.4 | —11.4 |
| Humphreys | 5,758 | — 2,145 | —27.1 | 12.7 | —17.9 | 13,335 | — 7,210 | —35.1 | 27.6 | —17.2 |
| Issaquena | 1,176 | — 642 | —35.3 | 12.4 | —27.3 | 2,400 | — 1,479 | —38.1 | 15.8 | —28.3 |
| LeFlore | 16,699 | — 2,230 | —11.8 | 14.8 | 1.3 | 30,443 | — 14,597 | —32.4 | 27.5 | —13.8 |
| Quitman | 7,715 | — 4,277 | —35.7 | 17.8 | —24.2 | 13,304 | — 6,741 | —33.6 | 27.7 | —15.3 |
| Sharkey | 3,247 | — 987 | —23.3 | 14.2 | —12.4 | 7,491 | — 4,235 | —36.1 | 27.5 | —18.5 |
| Sunflower | 14,730 | — 5,666 | —27.8 | 14.1 | —17.6 | 31,020 | — 17,046 | —35.5 | 26.0 | —18.7 |
| Tallahatchie | 8,580 | — 3,843 | —30.9 | 12.1 | —22.5 | 15,501 | — 9,389 | —37.7 | 28.2 | —20.1 |
| Tunica | 3,505 | — 1,082 | —23.6 | 16.5 | —11.1 | 13,321 | — 8,863 | —40.0 | 25.2 | —24.8 |
| Washington | 35,239 | 4,922 | 16.2 | 29.4 | 50.4 | 43,399 | — 14,596 | —25.2 | 23.2 | — 7.8 |
| Economic Area II | 91,602 | — 15,926 | —14.8 | 10.4 | — 5.9 | 145,185 | — 59,245 | —29.0 | 25.6 | —10.8 |
| Benton | 4,114 | — 1,276 | —23.7 | 9.0 | —16.8 | 3,609 | — 1,371 | —27.5 | 29.4 | — 6.3 |
| Carroll | 4,677 | — 2,286 | —32.8 | 4.5 | —29.8 | 6,500 | — 4,207 | —39.3 | 21.2 | —26.4 |
| De Soto | 9,248 | 119 | 1.3 | 13.0 | 14.5 | 14,643 | — 6,030 | —29.2 | 25.1 | —11.4 |
| Grenada | 9,352 | — 1,027 | — 9.9 | 15.3 | 3.9 | 9,057 | — 3,024 | —25.0 | 22.9 | — 7.9 |
| Holmes | 7,595 | — 1,916 | —20.1 | 7.8 | —13.9 | 19,501 | — 10,300 | —34.6 | 21.8 | —20.3 |
| Madison | 9,267 | — 622 | — 6.3 | 10.8 | 3.8 | 23,637 | — 8,230 | —25.8 | 27.8 | — 5.2 |
| Marshall | 7,264 | — 955 | —11.6 | 11.5 | — 1.5 | 17,239 | — 5,593 | —24.5 | 28.8 | — 2.8 |
| Panola | 12,565 | — 2,768 | —18.1 | 11.3 | — 8.8 | 16,226 | — 6,005 | —27.0 | 27.1 | — 7.2 |
| Tate | 7,696 | — 594 | — 7.2 | 8.5 | 0.7 | 10,442 | — 3,445 | —24.8 | 33.9 | 0.7 |
| Yalobusha | 6,962 | — 1,970 | —22.1 | 4.7 | —18.4 | 5,540 | — 2,699 | —32.8 | 23.7 | —16.8 |
| Yazoo | 12,862 | — 2,631 | —17.0 | 13.7 | — 5.6 | 18,791 | — 8,341 | —30.7 | 22.9 | —14.9 |
| Economic Area III | 114,048 | — 14,819 | —11.5 | 13.3 | 0.3 | 113,842 | — 32,290 | —22.1 | 22.6 | — 4.5 |
| Adams | 19,035 | — 1,501 | — 7.3 | 27.1 | 17.8 | 18,695 | — 1,501 | — 7.4 | 25.4 | 16.1 |
| Amite | 7,130 | — 2,273 | —24.2 | 6.6 | —19.2 | 8,443 | — 4,374 | —34.1 | 22.8 | —19.1 |
| Claiborne | 2,600 | — 617 | —19.2 | 6.9 | —13.6 | 8,245 | — 2,427 | —22.7 | 19.5 | — 7.7 |
| Copiah | 12,992 | — 2,357 | —15.4 | 8.0 | — 8.6 | 14,059 | — 6,133 | —30.3 | 24.0 | —13.7 |
| Franklin | 5,486 | — 1,748 | —24.2 | 9.1 | —17.2 | 3,800 | — 1,519 | —28.6 | 23.6 | —11.7 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Jefferson | 2,489 | — 494 | —16.6 | 3.3 | —13.8 | 7,653 | — 2,658 | —25.8 | 22.5 | — 9.1 |
| Lincoln | 18,407 | — 2,675 | —12.7 | 12.7 | — 1.6 | 8,352 | — 2,979 | —26.3 | 23.4 | — 9.1 |
| Pike | 19,655 | — 1,850 | — 8.6 | 10.7 | 1.2 | 15,408 | — 4,038 | —20.8 | 23.8 | — 1.9 |
| Warren | 22,447 | — 371 | — 1.6 | 16.9 | 15.0 | 19,759 | — 3,641 | —15.6 | 16.5 | — 1.7 |
| Wilkinson | 3,807 | — 933 | —19.7 | 8.8 | —12.6 | 9,428 | — 3,020 | —24.3 | 27.6 | — 3.4 |
| Economic Area IV | 132,708 | — 30,496 | —18.7 | 10.7 | —10.0 | 28,017 | — 10,259 | —26.8 | 22.7 | —10.2 |
| Alcorn | 21,949 | — 3,907 | —15.1 | 11.2 | — 5.6 | 3,333 | — 1,230 | —27.0 | 16.9 | —14.6 |
| Calhoun | 11,595 | — 3,819 | —24.8 | 9.5 | —17.6 | 4,346 | — 1,387 | —24.2 | 33.7 | 1.3 |
| Itawamba | 14,206 | — 3,701 | —20.7 | 10.0 | —12.7 | 874 | — 252 | —22.4 | 20.2 | — 6.7 |
| Lafayette | 14,110 | — 2,159 | —13.3 | 10.6 | — 4.1 | 7,245 | — 2,900 | —28.6 | 25.4 | —10.4 |
| Pontotoc | 13,946 | — 3,565 | —20.4 | 8.2 | —13.8 | 3,286 | — 1,183 | —26.5 | 17.1 | —13.9 |
| Prentiss | 15,763 | — 3,923 | —19.9 | 12.6 | — 9.8 | 2,186 | — 654 | —23.0 | 21.7 | — 6.3 |
| Tippah | 12,337 | — 3,287 | —21.0 | 10.5 | —12.7 | 2,756 | — 1,446 | —34.4 | 23.8 | —18.8 |
| Tishomingo | 13,210 | — 3,190 | —19.5 | 11.3 | —10.4 | 679 | — 230 | —25.3 | 12.8 | —15.8 |
| Union | 15,592 | — 2,945 | —15.9 | 11.5 | — 6.2 | 3,312 | — 977 | —22.8 | 18.0 | — 8.9 |
| Economic Area V | 120,148 | — 656 | — 0.5 | 14.0 | 13.4 | 79,858 | — 28,358 | —26.2 | 23.0 | — 9.2 |
| Chickasaw | 10,380 | — 1,413 | —12.0 | 12.0 | — 1.4 | 6,511 | — 3,729 | —36.4 | 21.5 | —22.7 |
| Clay | 9,214 | 353 | 4.0 | 15.7 | 20.3 | 9,719 | — 2,766 | —22.2 | 23.7 | — 3.7 |
| Lee | 30,300 | — 1,261 | — 4.0 | 14.4 | 9.9 | 10,289 | — 2,694 | —20.8 | 21.8 | — 3.5 |
| Lowndes | 28,871 | 5,975 | 26.1 | 17.8 | 48.5 | 17,768 | — 4,695 | —20.9 | 22.0 | — 3.5 |
| Monroe | 21,932 | — 3,342 | —13.2 | 10.7 | — 3.9 | 12,021 | — 4,428 | —26.9 | 19.9 | —12.3 |
| Noxubee | 4,724 | — 802 | —14.5 | 8.0 | — 7.7 | 12,102 | — 6,265 | —34.1 | 23.2 | —18.8 |
| Oktibbeha | 14,727 | — 166 | — 1.1 | 16.2 | 14.9 | 11,448 | — 3,781 | —24.8 | 29.6 | — 2.6 |
| Economic Area VI | 306,837 | — 56,396 | —15.5 | 11.7 | — 5.6 | 178,232 | — 64,726 | —26.6 | 23.8 | — 9.1 |
| Attala | 11,789 | — 4,620 | —28.2 | 8.8 | —21.8 | 9,546 | — 4,518 | —32.1 | 21.6 | —17.5 |
| Choctaw | 5,903 | — 2,336 | —28.4 | 7.3 | —23.1 | 2,520 | — 1,603 | —38.9 | 23.9 | —24.3 |
| Clarke | 10,001 | — 2,693 | —21.2 | 10.6 | —12.9 | 6,492 | — 2,966 | —31.4 | 20.0 | —17.6 |
| Covington | 8,896 | — 3,302 | —30.5 | 12.8 | —17.8 | 4,741 | — 1,844 | —28.0 | 26.3 | — 9.1 |
| Jasper | 8,402 | — 1,660 | —16.5 | 9.5 | 8.6 | 8,507 | — 3,519 | —29.3 | 23.7 | —12.5 |
| Jefferson Davis | 6,126 | — 1,621 | —20.9 | 12.4 | —11.1 | 7,414 | — 3,279 | —30.7 | 24.2 | —13.9 |
| Jones | 44,095 | — 4,490 | — 9.2 | 15.1 | 4.5 | 15,447 | — 3,401 | —18.0 | 25.4 | 2.9 |
| Kemper | 4,828 | — 1,954 | —28.8 | 5.0 | —25.3 | 7,449 | — 4,016 | —35.0 | 21.5 | —21.0 |
| Lauderdale | 43,635 | — 2,345 | — 5.1 | 12.7 | 7.0 | 23,484 | — 5,089 | —17.8 | 22.2 | 0.4 |
| Lawrence | 6,354 | — 2,348 | —27.0 | 10.4 | —19.4 | 3,861 | — 2,062 | —34.8 | 24.5 | —18.9 |
| Leake | 10,559 | — 2,993 | —22.1 | 8.9 | —15.2 | 8,101 | — 3,377 | —29.4 | 25.3 | —11.6 |

Table 5.—Components of Population Change, Mississippi Counties and State Economic Areas, 1950 to 1960. (Continued from Page 13.)

| Area | White | | | | | Nonwhite | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1960 Population | Net migration | | Natural increase | Net change | 1960 Population | Net migration | | Natural increase | Net change |
| | Number | Number | Percent* | Percent* | Percent* | Number | Number | Percent* | Percent* | Percent* |
| Marion | 15,408 | —2,482 | —13.9 | 14.9 | —1.1 | 7,885 | —2,391 | —23.3 | 22.4 | —6.0 |
| Montgomery | 7,349 | —1,561 | —17.5 | 8.1 | —10.9 | 5,971 | —1,865 | —23.8 | 25.9 | —4.1 |
| Neshoba | 15,026 | —6,190 | —29.2 | 11.3 | —21.2 | 5,901 | —2,606 | —30.6 | 27.6 | —11.5 |
| Newton | 12,950 | —3,334 | —20.5 | 9.8 | —12.7 | 6,567 | —2,967 | —31.1 | 21.4 | —16.4 |
| Rankin | 21,504 | 4,327 | 25.2 | 12.9 | 41.4 | 12,818 | —3,452 | —21.2 | 19.0 | —6.2 |
| Scott | 13,050 | —981 | —7.0 | 14.0 | 6.0 | 8,137 | —3,624 | —30.8 | 25.5 | —13.2 |
| Simpson | 13,254 | —2,940 | —18.2 | 11.3 | —8.9 | 7,200 | —1,940 | —21.2 | 25.7 | —1.0 |
| Smith | 11,056 | —3,821 | —25.7 | 11.4 | —17.2 | 3,247 | —1,285 | —28.4 | 33.7 | —4.2 |
| Walthall | 7,412 | —1,893 | —20.3 | 10.8 | —11.7 | 6,100 | —2,820 | —31.6 | 24.5 | —14.9 |
| Wayne | 10,449 | —2,061 | —16.5 | 15.9 | —3.2 | 5,809 | —1,931 | —24.9 | 24.5 | —6.6 |
| Webster | 7,938 | —1,649 | —17.2 | 7.5 | —11.0 | 2,642 | —753 | —22.2 | 26.1 | —1.9 |
| Winston | 10,853 | —3,449 | —24.1 | 10.5 | —16.1 | 8,393 | —3,418 | —28.9 | 27.1 | —9.7 |
| Economic Area VII | 94,523 | —6,576 | —6.5 | 16.7 | 9.1 | 29,507 | —2,990 | —9.2 | 25.6 | 14.0 |
| Forrest | 37,970 | 391 | 1.0 | 17.1 | 18.3 | 14,752 | —1,384 | —8.6 | 24.5 | 13.8 |
| George | 9,811 | —729 | —6.9 | 20.0 | 11.7 | 1,287 | —310 | —19.4 | 29.7 | 4.5 |
| Greene | 6,443 | —1,191 | —15.6 | 13.8 | —4.0 | 1,923 | —137 | —6.7 | 37.0 | 27.9 |
| Lamar | 11,443 | —1,422 | —11.1 | 15.7 | 2.9 | 2,232 | —393 | —15.0 | 24.6 | 6.0 |
| Pearl River | 17,221 | —1,739 | —9.2 | 17.4 | —6.2 | 5,190 | —515 | —9.0 | 27.0 | 15.5 |
| Perry | 6,333 | —1,625 | —20.4 | 15.4 | —8.2 | 2,412 | —270 | —10.1 | 21.3 | 9.1 |
| Stone | 5,302 | —261 | —4.7 | 13.6 | 8.2 | 1,711 | 19 | 1.1 | 24.0 | 25.3 |
| Economic Area VIII | 156,675 | 22,359 | 16.6 | 27.7 | 49.0 | 32,375 | 3,398 | 11.7 | 30.5 | 45.9 |
| Hancock | 11,784 | 549 | 4.9 | 14.0 | 19.6 | 2,255 | —47 | —2.0 | 12.9 | 10.6 |
| Harrison | 100,233 | 8,915 | 9.8 | 29.3 | 41.9 | 19,256 | 1,704 | 9.7 | 30.8 | 43.5 |
| Jackson | 44,658 | 12,895 | 40.6 | 28.8 | 81.1 | 10,864 | 1,741 | 19.1 | 35.4 | 61.3 |
| Economic Area A | 112,205 | 17,008 | 17.9 | 21.7 | 43.4 | 74,840 | —6,759 | —8.3 | 27.7 | 17.1 |
| Hinds | 112,205 | 17,008 | 17.9 | 21.7 | 43.4 | 74,840 | —6,759 | —8.3 | 27.7 | 17.1 |

*If percent of net migration is added to percent of natural increase in each area, the total does not exactly equal the percent of net change. This is because migration rates are calculated on the estimated residual 1960 population, while rates of natural increase and net change are figured on the 1950 population.

Data Sources: U. S. Bureau of the Census and Mississippi State Board of Health.

BULLETIN 633 DECEMBER 1961

# Influence Of
# Annual Fertilizer Applications On A Peach Orchard Soil

J. P. Overcash
S. P. Crockett
L. E. Gholston

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

## Conclusions

1. Annual applications of superphosphate at the rate of 6 pounds of 20% superphosphate under mature Sullivans Early Elberta peach trees resulted in increases in phosphorus in the soils at a depth of 0 to 6 inches.

2. Under very heavy rates of annual application the available phosphorus was significantly higher than the check trees to a depth of 12 to 18 inches.

3. Trees which received no phosphate fertilizer had analyses of 5 to 25 pounds of $P_2O_5$ equivalent per acre. These trees did not grow or yield as well as trees which received phosphate fertilizer and had higher phosphorus analyses in their soils.

4. Annual applications of 1 1/2 pounds of 50% muriate of potash to mature trees resulted in a large increase in exchangeable potassium in the soil at 0- to 6-inch depth.

5. Potassium analyses of less than 150 pounds per acre were typical for soils not receiving potash. Analyses of over 400 pounds per acre resulted from annual applications of potash.

6. Three times the rate of potash application mentioned above resulted in movement of this element downward to at least 18 to 24 inches.

7. Applications of nitrate of soda caused the pH of the soil to rise and applications of ammonium nitrate caused the pH to drop.

# INFLUENCE OF ANNUAL FERTILIZER APPLICATIONS ON A PEACH ORCHARD SOIL

By J. P. OVERCASH[1], S. P. CROCKETT[2] and L. E. GHOLSTON[3]

Peach orchards are often located on hillsides to provide good air drainage for frost protection. Often these hill soils are either already eroded or subject to erosion. In many instances the soils are not naturally as fertile as bottom soils or level soils which are less subject to erosion.

Since peach orchard soils are often low in readily available mineral nutrients, it would be desirable to know the influence of continual applications of phosphorus, potassium and nitrogen fertilizers on these soils. This information would help the growers to determine the need for additions of these fertilizers to their orchards to promote more tree growth and better yield.

A long-time fertilizer experiment at Holly Springs, Mississippi was used as a source of soil samples for this study. Very heavy annual rates of application of nitrogen, phosphorus and potassium fertilizers under part of the trees permitted a study of depth of movement of phosphorus and potassium in the soils which were cultivated shallow only. This information could be useful in interpreting tree growth, since peaches are a very deep rooted crop.

## Materials and Methods

An orchard of Sullivans Early Elberta peach trees was set in a Grenada silt loam soil in 1946. The trees were spaced 20 x 20 feet apart and annually a furrow was plowed between the rows to a depth of 12 inches to minimize cross-feeding between rows.

The orchard was clean cultivated during the summers with the area under the tree hoed clean. In the winter an oat cover crop was planted between the trees.

In the spring of 1948 one experiment was begun with two-tree plots surrounded by border trees. This NPK factorial experiment included nitrogen at the rate of one pound nitrate of soda or ½ pound of ammonium nitrate per tree per year of age. The phosphorus was applied at the rate of one pound of 20% superphosphate per tree per year of age, and the potassium at the rate of ¼ pound of 50% muriate of potash per tree per year of age. The maximum amount of fertilizer was reached at 6 years of tree age and this amount was continued thereafter.

In the spring of 1950 another experiment was begun on the border rows, between the NPK test rows of the first experiment. Three levels of NPK were used as follows: NPK at the rates described in the first experiment; 2 NPK at twice these rates per tree annually; and 3 NPK at three times the annual rates used for the NPK plots in the first experiment. At six years of age and each year thereafter the trees at the 3 NPK level each received 18 pounds of nitrate of soda or 9 pounds of ammonium nitrate, 18 pounds of 20% superphosphate and 4½ pounds of 50% muriate of potash.

All of the phosphate and potash fertilizer and two-thirds of the nitrogen were applied in the spring before growth began. The remainder of the nitrogen was applied in late June or early July. The fertilizer was distributed evenly over the area under the limb spread of the tree and mixed in the soil by hoeing shallow. In both experiments the treatments were located at random in each of four blocks in the orchard.

Beginning in 1948, and each year thereafter, soil samples were collected from one tree of each plot in the test orchard. The same trees were sampled annually. A total of one quart of soil per tree was formed by sampling the 0- to 6-inch depth in the undisked area under the trees using a composite of soil from 10 holes per tree. In 1958 soil samples were collected at 6-inch levels to 36 inches. In order to eliminate mixing of the various levels, a large hole was bored to the beginning of the new level; then a small hole was bored to the proper depth for the sample.

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[1] Horticulturist, Agri. Expt. Sta., [2] Superintendent, North Mississippi Branch Station, [3] Assoc. Agronomist, Agr. Extension Service.

The soil testing procedures were as follows:

pH — Soil reactions were determined on a soil-water suspension of a 1:2 ratio using a glass electrode.

Potash — Available potassium was measured by shaking 5 gms. of soil with 20 ml. (1:4 ratio) of a solution that was 0.5 N hydrochloric acid (HC1) and determined flameometrically using a Perkin-Elmer Flame-photometer.

Phosphorus — The available phosphorus was determined by procedure devised by Lancaster (unpublished data, 1955). Briefly, the method was as follows: 5 gms. of soil were shaken with 20 ml. of extracting solution for 10 minutes and phosphorus in the extracting solution determined colormetrically, according to the molybdenum blue procedure using 1-amino-2-napthol-4 sulfonic acid as a reducing agent. The extractant consisted of a solution that was of 0.35 N to acetic acid, 0.15 N to lactic acid, 0.03 N to $NH_4F$, 0.10 N to $(NH_4)_2SO_4$ and 0.21 N to NaOH. The pH of the final solution was 4.25 + .05 and was adjusted by adding glacial acetic acid or solid NaOH as required.

## Results

**Phosphorus:** The application of superphosphate fertilizer in the spring, either alone or with nitrogen or potash, always resulted in higher available phosphorus in the soil samples at 0 to 6 inches depth in late fall, table 1. The average available phosphorus in the soil under all trees receiving phosphate fertilizer was 286.6 pounds per acre for the five years shown in table 1. Whereas, for soils which received no phosphate fertilizer it was only 11.4 pounds. Neither nitrogen nor potassium had any significant influence on the analyses for phosphorus in the soils.

After eleven annual applications of phosphate fertilizers the soils were sampled in 6-inch levels to 36 inches to determine the downward movement of this element. When samples of soils under all trees receiving phosphate in the NPK factorial experiment were compared with those receiving none there were significantly

**Table 1.—The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the pounds of $P_2O_5$ equivalent per acre in the soil at a depth of 0 to 6 inches under Sullivans Early Elberta peach trees planted in 1946 at Holly Springs, Mississippi.**

| Treatment | 1949 | 1951 | 1953 | 1955 | 1957 |
|---|---|---|---|---|---|
| Nitrogen | 3.7 | 2.1 | 4.3 | 5.0 | 14.0 |
| Phosphorus | 135.5 | 219.0 | 291.5 | 367.0 | 393.0 |
| Potassium | 5.2 | 8.0 | 14.0 | 16.7 | 14.7 |
| Nitrogen, Phosphorus | 216.4 | 87.2 | 289.8 | 325.2 | 367.3 |
| Nitrogen, Potassium | 3.6 | 6.4 | 9.0 | 9.9 | 20.0 |
| Phosphorus, Potassium | 255.9 | 246.0 | 290.3 | 367.0 | 336.7 |
| Nitrogen, Phosphorus, Potassium | 380.9 | 168.7 | 241.0 | 360.7 | 336.7 |
| Check | 5.6 | 9.4 | 14.3 | 40.5 | 21.0 |
| L. S. D. .05 | 145.4 | 111.6 | 54.1 | 45.2 | 67.1 |
| .01 | 198.0 | 152.0 | 73.7 | 61.1 | 93.1 |
| Summary of means for all trees receiving each fertilizer element | | | | | |
| Nitrogen | 151.2 | 66.1 | 136.0 | 175.2 | 184.5 |
| No Nitrogen | 100.7 | 120.5 | 152.5 | 197.8 | 205.4 |
| Phosphorus | 247.2** | 180.2** | 278.1** | 355.0** | 372.5** |
| No Phosphorus | 4.7 | 6.4 | 10.4 | 18.0 | 17.4 |
| Potassium | 161.5 | 107.2 | 138.6 | 188.6 | 191.1 |
| No Potassium | 90.3 | 79.4 | 149.9 | 184.4 | 198.8 |

*Significant at .05 level. **Significant at .01 level.

higher amounts of phosphorus as deep as the 24- to 30-inch level as shown in table 2.

In the experiment with 3 rates of NPK fertilizer application the penetration of phosphorus under 3 (NPK) rate was significantly greater than the check to a depth of 12-18 inches—table 3. Over twice as much phosphorus was recorded at this depth.

**Potassium:** The addition of 1 1/2 pounds of 50% muriate of potash under mature peach trees in the NPK factorial experiment resulted in an average analysis for the five years shown in table 4 of 433.8 pounds of potassium per acre as contrasted to only 122.5 pounds where none was added. The addition of nitrogen fertilizer resulted in significantly lower analyses for potassium in four out of five years shown in table 4. When nitrogen was applied, larger trees resulted, and therefore the trees required a larger part of the potassium available in the soil. This greater consumption by the trees may have been responsible in part for the lower analyses.

The average pounds of exchangeable potassium in the soil per acre for the five years shown in table 4 was 152.7 for check trees; 278.4 for NPK trees and 591.7 for the trees receiving only potash fertilizer. This indicates that part of the potash applied under the NPK trees was used by the greater tree growth which resulted, in contrast to the trees receiving only potash which had higher potassium analyses.

**Table 2.—The influence of annual applications of nitrogen, phosphorus and potassium fertilizers under Sullivans Early Elberta peach trees planted in 1946 at Holly Springs, Mississippi on the pounds of $P_2O_5$ equivalent per acre in the soil at various depths in the fall of 1958.**

| Treatment | Soil sampling depth — inches | | | | | |
|---|---|---|---|---|---|---|
| | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 |
| Nitrogen | 25.7 | 14.7 | 6.3 | 18.0 | 25.0 | 20.0 |
| Phosphorus | 393.0 | 28.3 | 24.3 | 28.0 | 24.3 | 20.7 |
| Potassium | 33.0 | 20.3 | 13.0 | 10.3 | 21.6 | 19.0 |
| Nitrogen, Phosphorus | 393.0 | 26.0 | 17.3 | 18.6 | 45.6 | 18.0 |
| Nitrogen, Potassium | 17.3 | 17.3 | 18.7 | 18.6 | 21.0 | 12.7 |
| Phosphorus, Potassium | 393.0 | 27.0 | 23.0 | 25.3 | 35.0 | 21.0 |
| Nitrogen, Phosphorus, Potassium | 393.0 | 25.0 | 32.3 | 25.6 | 18.0 | 21.0 |
| Check | 25.0 | 28.3 | 18.3 | 25.6 | 18.6 | 21.3 |
| L. S. D. .05 | 6.8 | 18.2 | 18.1 | 8.8 | 11.7 | 10.1 |
| .01 | 9.4 | 25.3 | 25.1 | 12.2 | 16.2 | 14.1 |
| Summary of means for all treatments receiving each fertilizer element. | | | | | | |
| Nitrogen | 207.2 | 20.7 | 18.6 | 20.3 | 27.4 | 17.9 |
| No Nitrogen | 211.0 | 26.0 | 19.7 | 22.3 | 24.9 | 20.7 |
| Phosphorus | 393.0** | 26.5 | 24.3* | 24.4** | 30.7** | 20.4 |
| No Phosphorus | 25.2 | 20.2 | 14.0 | 18.2 | 21.6 | 18.2 |
| Potassium | 209.0 | 22.4 | 21.7 | 20.0 | 23.9 | 18.6 |
| No Potassium .... | 209.2 | 25.3 | 16.6 | 22.6 | 28.4 | 20.0 |

*Significant at .05 level.

**Significant at .01 level.

**Table 3.—The influence of three rates of annual application of nitrogen, phosphorus and potassium fertilizers under Sullivans Early Elberta peach trees planted in 1946 at Holly Springs, Mississippi on the pounds of $P_2O_5$ equivalent per acre in the soil at various depths in the fall of 1958.**

| Rates of Fertilizer | Soil sampling depth — inches | | | | | |
|---|---|---|---|---|---|---|
| | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 |
| Check | 25.0 | 28.3 | 18.3 | 25.7 | 18.7 | 21.3 |
| NPK | 393.0 | 34.3 | 32.3 | 25.7 | 18.0 | 21.0 |
| 2 (NPK) | 393.0 | 52.3 | 27.0 | 26.3 | 22.3 | 19.3 |
| 3 (NPK) | 393.0 | 178.7 | 43.7 | 26.7 | 21.0 | 20.3 |
| L. S. D. .05 | 1.8 | 31.9 | 8.8 | 9.0 | 13.5 | 16.0 |
| .01 | 2.8 | 48.3 | 13.5 | 13.6 | 20.4 | 24.3 |

After eleven annual applications of muriate of potash the soil analyses showed (table 5) that the potassium had moved downward below the 0 to 6-inch level. Where potash alone was applied to the soil the concentration was higher than for check plots at a depth of 18 to 24 inches. The application of nitrogen fertilizer and the subsequent greater tree size resulted in significantly lower potassium analyses to a depth of 12-18 inches.

The exchangeable potassium was significantly higher under trees receiving 2 (NPK) than the check at a depth of 0 to 6 inches (table 6). When the heavier application of potash was applied under the 3(NPK) trees the potassium was higher than the check to a greater depth (18 to 24 inches).

**Nitrogen:** Two sources of nitrogen fertilizers were used in the NPK factorial experiment. In 1948, 1949, and 1950 ni-

**Table 4.—The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the pounds of exchangeable potassium per acre in the soil at a depth of 0 to 6 inches under Sullivans Early Elberta peach trees planted in 1946 at Holly Springs, Mississippi**

| Treatment | 1954 | 1955 | 1956 | 1957 | 1958 |
|---|---|---|---|---|---|
| Nitrogen | 178.5 | 209.7 | 102.7 | 75.3 | 161.7 |
| Phosphorus | 132.7 | 134.2 | 61.5 | 76.7 | 99.3 |
| Potassium | 534.0 | 650.0 | 572.0 | 552.3 | 650.0 |
| Nitrogen, Phosphorus | 127.7 | 161.7 | 48.7 | 42.0 | 73.7 |
| Nitrogen, Potassium | 466.7 | 526.7 | 269.5 | 409.3 | 319.3 |
| Phosphorus, Potassium | 532.2 | 625.7 | 459.7 | 379.0 | 305.0 |
| Nitrogen, Phosphorus, Potassium | 341.5 | 455.0 | 298.0 | 155.0 | 175.3 |
| Check | 188.0 | 155.0 | 122.7 | 155.0 | 142.7 |
| L. S. D. .05 | 317.1 | 124.1 | 154.6 | 106.5 | 177.1 |
| .01 | 431.6 | 168.9 | 210.5 | 147.8 | 245.9 |
| Summary of means for all trees receiving each fertilizer element | | | | | |
| Nitrogen | 278.6* | 338.3 | 179.7** | 170.4** | 182.5** |
| No Nitrogen | 346.7 | 391.3 | 304.0 | 290.7 | 299.2 |
| Phosphorus | 283.5 | 344.2 | 217.0 | 163.1** | 163.3** |
| No Phosphorus | 341.8 | 385.4 | 266.7 | 298.0 | 318.4 |
| Potassium | 468.6** | 564.4** | 399.8** | 373.9** | 362.4 |
| | | | | | 362.4** |
| No Potassium | 156.7 | 165.2 | 83.9 | 87.2 | 119.3 |

**Table 5.—The influence of annual applications of nitrogen, phosphorus and potassium fertilizers under Sullivans Early Elberta peach trees planted in 1946 at Holly Springs, Mississippi on the pounds of exchangeable potassium per acre in the soil at various depths in 1958.**

| | Soil sampling depth — inches | | | | | |
|---|---|---|---|---|---|---|
| Treatment | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 |
| Nitrogen | 161.7 | 52.7 | 74.7 | 84.3 | 68.3 | 75.6 |
| Phosphorus | 99.3 | 49.7 | 67.0 | 86.3 | 76.7 | 97.3 |
| Potassium | 650.0 | 190.3 | 83.7 | 89.7 | 60.7 | 66.0 |
| Nitrogen, Phosphorus | 73.7 | 39.7 | 52.0 | 70.0 | 53.0 | 67.0 |
| Nitrogen, Potassium | 319.3 | 77.0 | 52.7 | 74.7 | 56.3 | 78.0 |
| Phosphorus, Potassium | 305.0 | 110.3 | 89.7 | 80.3 | 55.0 | 56.3 |
| Nitrogen, Phosphorus, Potassium | 175.3 | 54.0 | 54.0 | 66.7 | 81.0 | 59.3 |
| Check | 142.7 | 56.0 | 62.7 | 70.7 | 90.7 | 81.3 |
| L. S. D. .05 | 177.1 | 49.6 | 20.6 | 17.2 | 20.7 | 26.1 |
| .01 | 245.9 | 68.8 | 28.7 | 23.9 | 28.8 | 36.2 |
| Summary of means for all treatments receiving each fertilizer element | | | | | | |
| Nitrogen | 182.5* | 55.8** | 58.3** | 73.9 | 64.7 | 70.0 |
| No Nitrogen | 299.2 | 101.6 | 75.7 | 81.7 | 70.7 | 75.3 |
| Phosphorus | 163.3** | 63.4* | 65.6 | 75.8 | 66.4 | 70.1 |
| No Phosphorus | 318.4 | 94.0 | 68.4 | 79.8 | 69.0 | 75.2 |
| Potassium | 362.4** | 107.9** | 70.0 | 77.8 | 63.2 | 64.9 |
| No Potassium | 119.3 | 49.5 | 64.0 | 77.8 | 72.2 | 80.4 |

*Significant at .05 level. **Significant at .01 level.

**Table 6.—The influence of three rates of annual application of nitrogen, phosphorus and potassium fertilizers under Sullivans Early Elberta peach trees planted in 1946 at Holly Springs, Mississippi on the pounds of exchangeable potassium per acre in the soil at various depths in 1958.**

| | Soil sampling depth — inches | | | | | |
|---|---|---|---|---|---|---|
| Treatment | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 |
| Rates of fertilizer | | | | | | |
| Check | 142.7 | 56.0 | 62.7 | 70.7 | 90.7 | 81.3 |
| NPK | 175.3 | 54.0 | 54.0 | 66.7 | 81.0 | 59.3 |
| 2 (NPK) | 490.3 | 156.0 | 95.0 | 93.0 | 68.0 | 74.7 |
| 3 (NPK) | 577.7 | 319.3 | 135.3 | 112.3 | 87.3 | 92.0 |
| L. S. D. .05 | 121.5 | 181.5 | 38.2 | 34.8 | 42.5 | 45.2 |
| .01 | 184.1 | 275.0 | 57.9 | 52.7 | 64.3 | 68.5 |

**Table 7.—The influence of source of nitrogen* fertilizer on pH of soils at a depth of 0 to 6 inches in a Sullivans Early Elberta peach orchard at Holly Springs, Mississippi.**

| Treattment | 1948 | 1950 | 1953 | 1956 | 1958 |
|---|---|---|---|---|---|
| Nitrogen | 5.37 | 6.49 | 4.66 | 5.54 | 5.00 |
| Phosphorus | 4.98 | 4.95 | 5.77 | 5.10 | 4.50 |
| Potassium | 5.10 | 5.24 | 5.27 | 5.10 | 4.63 |
| Nitrogen, Phosphorus | 5.32 | 5.90 | 4.80 | 5.55 | 4.87 |
| Nitrogen, Potassium | 5.56 | 6.25 | 4.82 | 5.61 | 5.53 |
| Phosphorus, Potassium | 5.05 | 4.87 | 5.31 | 5.16 | 5.12 |
| Nitrogen, Phosphorus, Potassium | 5.39 | 5.62 | 4.77 | 5.47 | 5.00 |
| Check | 5.22 | 5.37 | 5.26 | 5.20 | 5.00 |
| **L. S. D. .05** | .36 | .24 | .28 | .24 | .29 |
| .01 | .49 | .32 | .38 | .33 | .40 |
| Summary of means for all trees receiving each fertilizer element | | | | | |
| Nitrogen | 5.41* | 6.06** | 4.77** | 5.54** | 5.10** |
| No Nitrogen | 5.08 | 5.12 | 5.29 | 5.16 | 4.82 |
| Phosphorus | 5.17 | 5.34** | 5.04 | 5.32 | 4.88** |
| No Phosphorus | 5.32 | 5.84 | 5.02 | 5.38 | 5.04 |
| Potassium | 5.27 | 5.49 | 5.06 | 5.35 | 5.08** |
| No Potassium | 5.22 | 5.69 | 5.00 | 5.35 | 4.84 |

*1948-1950 nitrate of soda
1951-1953 ammonium nitrate
1954-1957 nitrate of soda
1958 ammonium nitrate

*Significant at .05 level
**Significant at .01 level

trate of soda was used in both spring and summer applications. This fertilizer resulted in raising the pH from an average of 5.12 for all trees receiving no nitrogen to 6.06 for all trees receiving this fertilizer, see table 7.

When the source of nitrogen was changed to ammonium nitrate the pH after three more years was reduced from 5.29 for all trees receiving no nitrogen to 4.77.

The most pronounced changes in pH were observed when nitrogen alone was applied as compared with the check trees. The soil under the NPK trees was apparently buffered against such wide changes in pH by the nitrogen sources.

BULLETIN 634 DECEMBER 1961

# Effects Of Continuous Dosage Of Penicillin For Control Of Bloat In Steers

By
H. W. Essig
C. B. Shawver
L. W. Williams

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
STATE COLLEGE MISSISSIPPI

## Summary and Conclusions

During the 1958 and 1959 pasture seasons penicillin was administered to steers grazing Ladino clover to determine how long penicillin was effective in controlling incidence and severity of bloat.

From the results of this two-year study it appeared that penicillin administered at the rate of 100 mg. per day was effective in controlling bloat for 14 to 17 days. The average daily severity of bloat increased after 17 days, however, it was not as high as the severity for non-penicillin treated controls. The average daily incidence of bloat increased to a maximum (2.0) after 21 days and fluctuated near the maximum for the next 15 days.

These results confirm previous recommendations that penicillin-salt feeding should not be started until it is needed. One should not start feeding penicillin when a bloat situation is anticipated, but should remove all salt and wait until bloat starts occurring before feeding penicillin-salt. Penicillin-salt should not be fed longer than 21 days for maximum protection from bloat.

# EFFECTS OF CONTINUOUS DOSAGE OF PENICILLIN FOR BLOAT CONTROL IN STEERS

By H. W. ESSIG, C. B. SHAWVER and L. W. WILLIAMS

Bloat in animals grazing legumes causes an extremely large economic loss to cattle. Administration of penicillin and other antibiotics has been reported to prevent bloat for varying periods of time.

Barrentine, et al (1956) reported that either procaine or potassium penicillin (50 mg. per animal) administered either by capsule or in an aqueous suspension as a drench to yearling steers grazing Ladino clover gave protection for periods of 1.5 to 3 days. In later work reported by Barrentine (1958) penicillin-salt mixtures were observed to become less effective in preventing bloat after prolonged use and the decreased efficiency began to occur after the cattle had received penicillin continuously for 10 to 14 days. Thomas (1956) observed no severe bloating in cattle during the period from 12 to 96 hours after each animal had been given 100 mg. of procaine penicillin. Brown, et al (1958) reported that 75 mg. of penicillin provided in a feed supplement reduced bloat when first administered to steers receiving alfalfa soilage, however, later in the season animals fed penicillin had as high an incidence and severity of bloat as did the controls.

In previous work at the Mississippi Agricultural Experiment Station Dr. Ben F. Barrentine observed that penicillin becomes less effective in preventing bloat after prolonged use. (Mississippi Farm Research July 1958).

This study was undertaken to determine the length of time that penicillin would control bloat in steers grazing Ladino clover and also to determine when or if the incidence and severity of bloat would return to as high a level as before administration of penicillin.

## Experimental Procedure

Paddocks containing almost pure stands of Ladino clover were used in this study. Steers grazed the clover for 90 minutes, morning and afternoon (7:30 A.M. and 2:30 P.M.), making it possible for each steer to bloat twice daily (possible daily incidence of 2.0 per steer). At the end of each grazing period the steers were checked for bloat and put in drylot with shade and water. Bloat was determined by visual observation. Severity was rated as not bloated (0), slightly bloated (1), moderately bloated (2), or severely bloated (3). The maximum daily severity rating was 6 per steer, assuming a steer bloated severely twice in one day.

The individual daily severity scores for all animals on a treatment were averaged to give an "average daily severity". The "average daily incidence" was determined in the same manner. The maximum "average daily incidence" was 2.0.

In trial 1, conducted during the summer of 1958, 10 steers which had been classified as bloaters were subjected to the above bloat producing procedure. They were allowed to graze Ladino clover for seven and one-half days prior to administration of penicillin so that each steer would serve as his control. Steers were given penicillin, by capsule, for a 20-day period at the rate of 100 mg. per day (400 mg. of 50% feed grade penicillin every second day). The penicillin treatment was started after the morning grazing of the eighth day of the trial. Steers were maintained on Ladino clover for four days after cessation of penicillin treatment.

In trial 2, conducted during the summer of 1959, eight steers which were

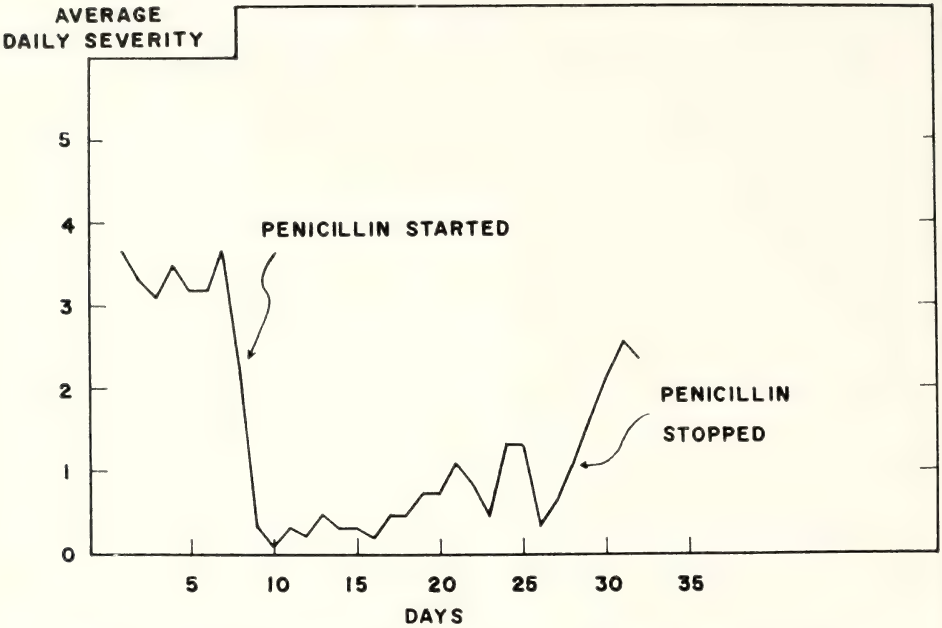

**Figure 1. Trial 1. Average daily severity on a per steer basis for 32 days.**

bloating readily were divided into two goups. One group of four steers served as controls (non-treated) and the other group was given penicillin, by capsule, for a 36-day period at the rate of 100 mg. per day (400 mg. of 50% feed grade penicillin every second day). Penicillin treatment was not started until the study had been in progress for four and one-half days. This four and one-half day period served as a control period as well as a period for assuring that all steers bloated readily.

## Results and Discussion

**Trial 1.** Severity and incidence of bloat for the summer of 1958 are shown in Table 1. For a 7.5 day pretreatment control period there was an incidence of 84 and a severity index of 59. When the animals were administered penicillin at a rate of 100 mg. per day, the incidence index decreased to 15 and the severity index decreased to 9, indicating that penicillin decreased both incidence and severity for 20 days. When penicillin administration was terminated, the incidence and severity again increased to a level approximately three times as high as when penicillin was administered.

Figures 1 and 2 show the average daily severity which dropped from approximately 3.3 to 0.3 for the 20 days during which penicillin was administered. Figure 1 shows that there was a slight increase in average daily severity during the last

Table 1.—Trial 1 (1958) severity and incidence of bloat

| | Incidence | | | | Severity | | |
|---|---|---|---|---|---|---|---|
| Period | Days | Possible | Observed | Index[1] | Possible | Observed | Index[1] |
| Control | 7.5 | 150 | 126 | 84 | 450 | 265 | 59 |
| Penicillin treated | 20 | 400 | 61 | 15 | 1200 | 105 | 9 |
| Postpenicillin treated | 5 | 100 | 48 | 48 | 300 | 108 | 36 |

[1] Index expressed as percent.

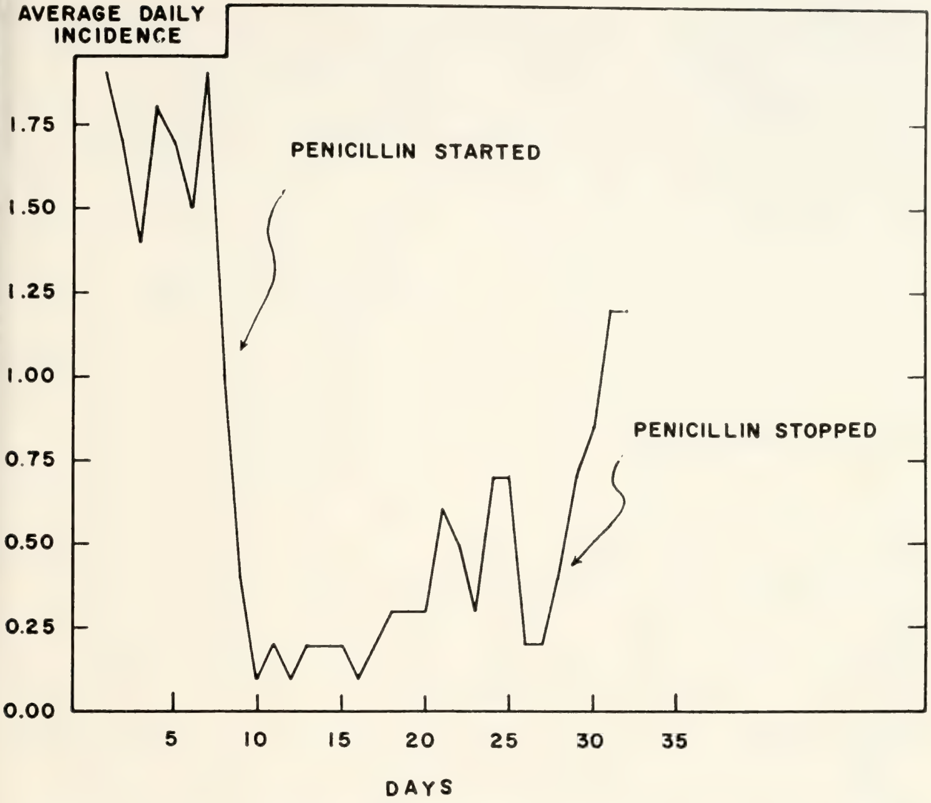

**Figure 2. Trial 1. Average daily incidence on a per steer basis for 32 days.**

one-third of the penicillin treatment period. This increase, however, was extremely slight and variable. Figure 2 shows that when penicillin treatment was started the average daily incidence of bloat decreased from approximately 1.75 to 0.3, however, there was a higher average daily incidence during the last one-third of the treatment than during the first two-thirds.

The increase of incidence and severity during the latter portion of the treatment indicated that penicillin was losing some of its effectiveness in controlling bloat.

**Trial 2.** Since it was apparent from trial 1 that after 14 days penicillin appeared to become less effective Trial 2 was initiated to determine when penicillin lost its effectiveness. These results, shown in table 2, indicate that some degree of protection was furnished by penicillin throughout the 36-day treatment period.

One steer in the penicillin treated group died after 19.5 days, whereas all of the nontreated steers had died by the 20th day. Therefore, the penicillin treatment period was divided into two periods (19.5 day and 16.5 day), and it was apparent that penicillin treatment was more effective during the first 19.5 days in controlling incidence and severity than in the last 16.5 days. Even though the index for the last 16.5 days was high, it was not as high as for the initial 19-day period for non-treated steers, indicating that penicillin was giving a slight degree of protection.

Figures 3 and 4 indicate that penicillin afforded satisfactory control of both in-

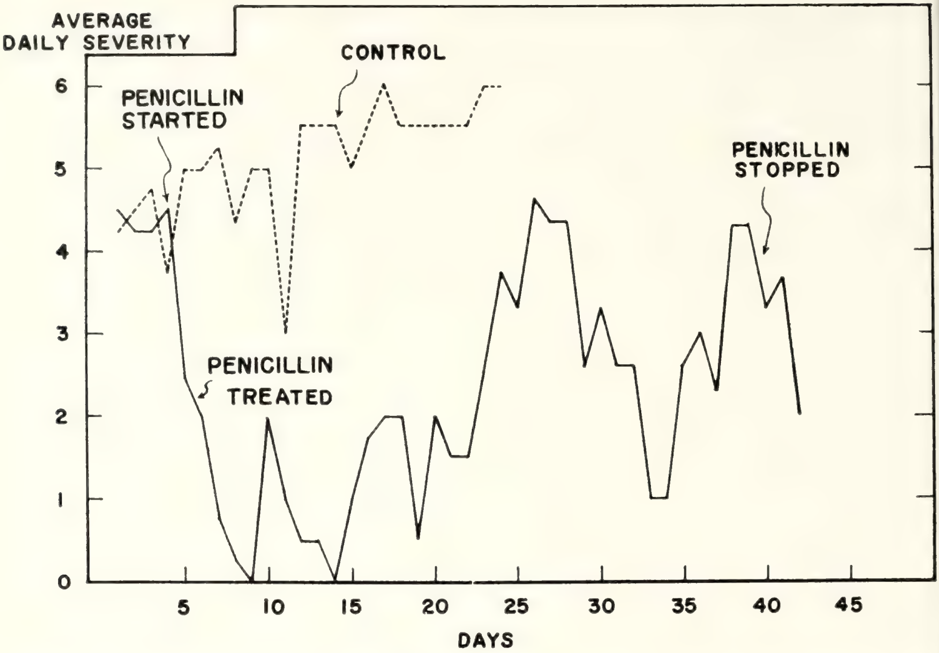

**Figure 3. Trial 2. Average daily severity on a per steer basis for treated and control steers.**

cidence and severity for 17 days. After 17 days control was quite variable. Average daily incidence reached the maximum (2.0) 21 days after beginning treatment and remained for three days. Eight days after the maximum was attained the daily incidence dropped to 0.67 from which the average daily incidence again returned to the maximum (2.0) in 4 days. The average daily severity fluctuated as did incidence; however, for the treated steers it never reached as high a level as the non-treated control steers. This indicated that penicillin afforded some protection from severity even though the incidence returned to a level comparable to that observed for the controls for the 19 days which they survived the test.

Table 2.—Trial 2 (1959) severity and incidence of bloat.

| | Incidence | | | | Severity | | |
|---|---|---|---|---|---|---|---|
| Period | Days | Possible | Observed | Index[1] | Possible | Observed | Index[1] |
| Penicillin | | | | | | | |
| Pre test | 4.5 | 36 | 36 | 100 | 108 | 80 | 74 |
| Total treated | 36.0 | 249 | 123 | 49 | 747 | 245 | 33 |
| Period a | 19.5[2] | 156 | 50 | 32 | 468 | 102 | 22 |
| Period b | 16.5[3] | 93 | 73 | 78 | 279 | 143 | 51 |
| Post treated | 2.5 | 15 | 11 | 73 | 45 | 24 | 53 |
| No penicillin | | | | | | | |
| Pre test | 4.5 | 36 | 35 | 97 | 108 | 79 | 73 |
| Controls | . .[4] | 92 | 91 | 99 | 276 | 239 | 87 |

[1] Index expressed as percent.

[2] 1st 19.5 days on penicillin at which time 1 steer died.

[3] Period of 20 through 36 days on penicillin.

[4] Steers died as follows: 1 on 3rd; 1 on 6th; 1 on 19th and 1 on 20th days.

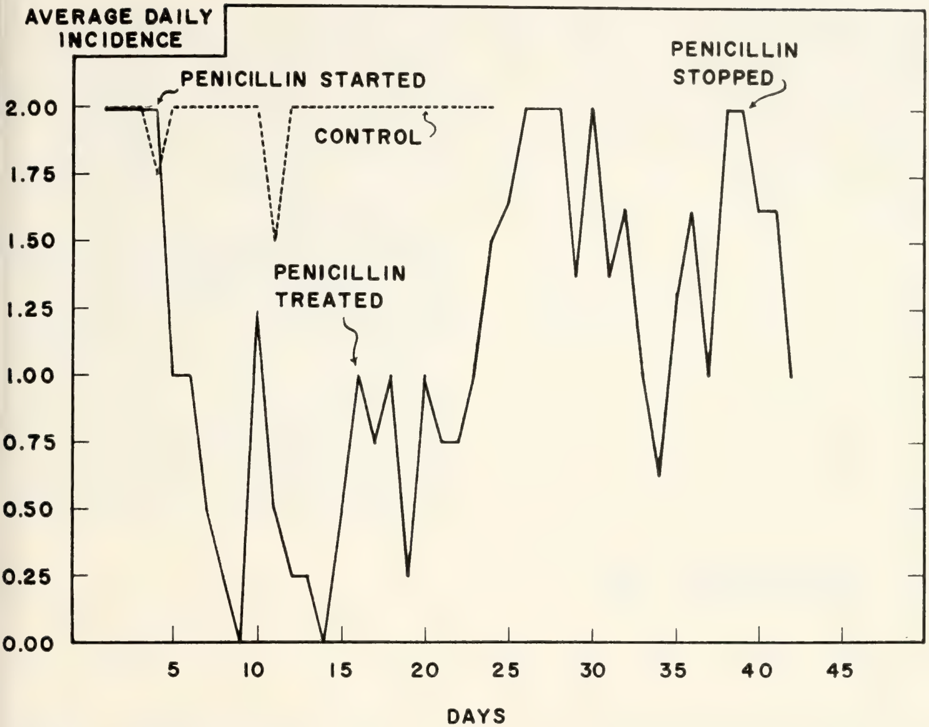

**Figure 4. Trial 2. Average daily incidence on a per steer basis for treated and control steers.**

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# Boron for Cotton

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HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

**On the cover:** Individual plants from plots fertilized and not fertilized with boron. Note sparse fruiting and compact bushy appearance of the top of the plant from the no boron plot.

# Boron Now Recommended For Cotton

By J. D. LANCASTER, B. C. MURPHY, B. C. HURT, JR., B. L. ARNOLD, R. E. COATS, R. C. ALBRITTON, AND LOUIE WALTON[1]

On the basis of recent experimental results along with the observation of severe boron deficiency in many farm fields, it is recommended that cotton in the Hill Section of Mississippi be fertilized with boron. Fertilization of soils in the Delta-Foothills with boron may also be beneficial particularly following the application of lime.

Cotton may be fertilized with boron (1) by applying a borated fertilizer, (2) by foliar application perhaps with insecticide solution at regular intervals during fruiting period, and (3) by the direct application of borate fertilizers to the soils. To obtain uniform distribution with direct application, it is recommended that a borate solution be sprayed on the soil either before, after, or during seed bed preparation.

Sixteen chemical elements are known to be essential for the normal growth and reproduction of crop plants, as well as many other plants. Of these elements, seven are required in very small amounts, and, accordingly are often referred to as "trace" or "minor" elements. More appropriate terminology which is now gaining in usage, refers to them as micronutrients, micro meaning a small amount. The micronutrients are: iron, copper, manganese, zinc, boron, molybdenum, and chlorine.

In an illustration of the small amounts of some of these nutrients that are actually required, a mature crop of cotton yielding two bales per acre may contain as little as 0.1 pound of boron in the aboveground portion, while the amount of molybdenum may be no more than 0.005 pounds per acre. An apt expression in this connection is that "a little switch starts a big motor."

Just as with nitrogen, phosphate, or potash, a deficiency of any of the micronutrients will result in a reduction in yield and possibly in quality as well. Sometimes, too much of one of the micronutrients may be present causing toxicity and reduced yields. Therefore, there may be a problem not of too little, but of too much. Both problems have been encountered in Mississippi: Namely, manganese toxicity (crinkle leaf) and boron deficiency. In a report on manganese toxicity in **Mississippi Farm Research,** December, 1953 it was pointed out that the toxic condition occurs on rather acid soils and is easily corrected by liming.

## Evidence and Symptoms Of Boron Deficiency

The first evidence in Mississippi of boron deficiency in cotton was obtained at the North Mississippi Branch Station, Holly Springs (1941-43) by Dr. Russell Coleman. Yield increases attributed to boron ranged from around 50 to 200 pounds of seed cotton per acre and apparently were associated with an increase both in the number and size of the bolls. Yield increases were obtained on both limed and unlimed soil, but were greater on limed soil. Study of soils collected from the resource areas of the state indicated that soils of the Delta Area contained much higher levels of available boron than did those of the Hill Section, especially the sandy loam and silt loam soils of the Hill Section. However, fertilization of cotton with boron was not recommended at that time and no further work was done for several years.

In 1954, research work in cotton fert-

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[1] Appreciation is extended to W. Y. Parker, County Agent, Yalobusha County, for his interest in and assistance with experiments conducted there.

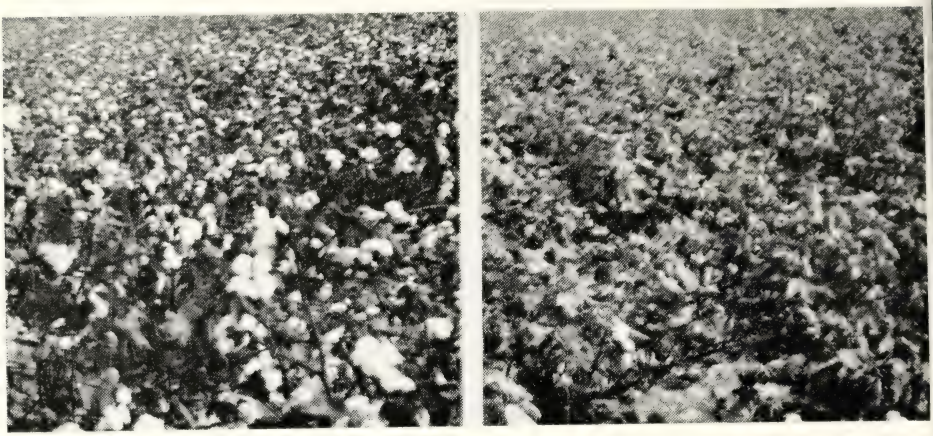

**Figure 1. On the left is a nearly normal crop. On the right, an adjacent area of the same field is extremely deficient in boron and the cotton is sparsely fruited, stunted and vegetative.**

ilization was greatly expanded. One of the treatments included in many of the experiments was the addition to the fertilizer of a micro-nutrient mixture, or of boron. One of a micro-nutrient mixtures employed was Fritted Trace Elements (FTE N-502) a product supplied by the Ferro Corporation, Cleveland, Ohio. The FTE contained 3.9% iron, 9.7% manganese, 2.0% copper, 4.0% zinc, 2.8% boron, and 0.13% molybdenum and was applied at the rate of 50 pounds per acre. The other micro-nutrient mixture, EsMinEl, was obtained from the Tennessee Corporation, Atlanta, Georgia. One ton of the EsMinEl contained approximately 835 pounds of manganese sulfate, 300 pounds ferric sulfate, 200 pounds of zinc sulfate, 300 pounds of copper sulfate, 300 pounds of magnesium sulfate and 30 pounds of Borax. Ninety pounds of EsMinEl was mixed with 10 pounds of either colemanite or borax and 50 pounds of the mixture applied per acre.

Where boron was the only micronutrient added, the source was either borax or colemanite and the rate either 0.5 or 1.0 pound per acre. A few other experiments were conducted (Black Belt, Pontotoc and North Mississippi Stations) in which certain of the micronutrients were applied separately and in combination. Molybdenum was applied either as a foliar spray or as a soil-foliar combination. Soil application of the other nutrients with the NPK fertilizer was made.

Results of these tests are summarized in Table 1. As summarized, these data provide no convincing evidence that micronutrients are needed in the fertilizer for cotton. The largest increase was for mixtures of micronutrients containing boron, or for boron alone. Among these trials, a statistically significant increase (odds 9:1) was obtained for boron at the Pontotoc Station, one year; at the North Mississippi Station for a micro-nutrient mixture, three years; and on farm fields with a micronutrient mixture, one year. In a little more than 60% of the trials, a higher yield was obtained with either a micronutrient mixture or boron than where neither was applied. In view of the lack of response to either zinc, copper or molybdenum and in terms of subsequent findings, practically all, if not all of the increase in yield associated with the micronutrient mixtures is attributed to boron.

In 1958, at the Pontotoc Station a serious production problem was encountered with cotton on an acid soil which had been limed to around pH 6.4. The problem had been recognized before the soil was limed, but it became somewhat more acute afterwards. In some areas, the cotton completely failed to produce mature bolls, although the plants appeared to be normal in other respects. There were no obvious vegetative abnormalities such as severe stunting or leaf-chlorosis. Throughout the fruiting period, the cotton put on squares and bloomed in what then appeared to be a normal manner, but the bolls were shed usually long before they were half-grown.

Based on fertilization practices and a limited chemical analysis of leaves from the affected plants it was concluded that a micronutrient deficiency was involved. In subsequent field experiments, it was established that the trouble was due to boron deficiency.

During a drought in the summer of 1960, there were several reports of unusually severe shedding by cotton, not only of squares, but of bolls as well, sometimes nearly grown bolls. In some of the fields, there were small areas where the cotton was moderately to severely stunted and excessively branched giving the cotton a distinctly bushy .appearance One such area is shown in Figure 1. Close examination revealed that the extremities of the main stem and branches were extremely rosetted (dwarfed). In some instances, the terminal bud had died. Such plants failed to develop mature bolls even though some squares, blooms and small bolls were produced. Cotton, so affected, remained vegetative and retained its leaves until frost.

In other parts of the field, the only obvious abnormality was severe shedding. In some instances, plants that were not particularly stunted failed to produce mature bolls; in others, small often imperfectly shaped bolls were produced. Such bolls opened slowly and never fully, and the cotton generally was not fluffy (hard-locked); there was a reduction both in the number and size of locks which shows that boron deficiency interferes with reproductive processes in cotton. Bolls on boron-deficit cotton seemed to be more susceptible to rot, both before and after opening. A range of the boll characteristics at the Moore Farm in Yalobusha County, 1961, is shown in Figure 2. Severely boron-deficient cotton is difficult to pick by hand and almost impossible to pick efficiently by machine.

In many cases, the nectaries at the base of squares and sometimes bolls had ruptured giving rise to an exudate which formed a ribbon-like protrusion upon drying. It was also noted that leaf petioles were often encircled by very dark green bands at irregular intervals giving an

**Table 1.—Response of cotton in the hill section to micronutrients applied separately and in combination 1950-1960**

| Micronutrient Treatment | Location Years | Pounds of seed cotton per acre<br>Without Micro-Nutrient | <br>With Micro-Nutrient |
|---|---|---|---|
| Combination[1] And/or Boron | 72 | 1864 | 1893 |
| Copper As copper sulphate | 7 | 1643 | 1574 |
| Zinc As zinc sulphate | 10 | 1687 | 1688 |
| Molybdenum, As ammonium molybdate | 4 | 1720 | 1731 |

[1] The combination was supplied either by Fritted Trace Elements (a slag containing iron, manganese, zinc, copper, boron, and molybdenum) or by EsMinEl (a mixture of soluble salts of iron, manganese, zinc, copper and boron). Boron was applied either as colemanite or Agricultural Borax.

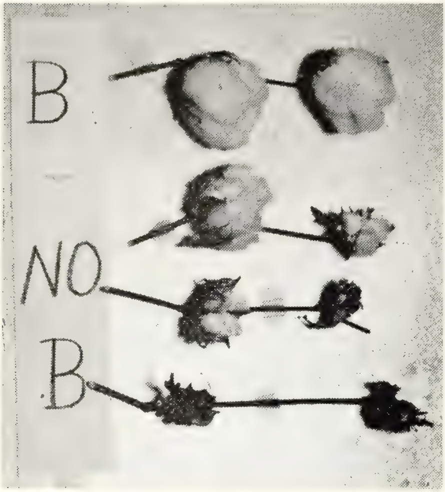

**Figure 2. A range of the boll condition observed at Moore farm, 1961. The large, fluffy bolls were from the boron-treated plots. Without boron the bolls were small, failed to open properly, and many rotted before opening.**

appearance that has been termed "banded petioles." When such petioles were sliced open, it was noted that the pith directly beneath the dark bands was almost always necrotic (dead).

One area of moderately stunted cotton on the Rufus Purdy Farm in Yalobusha County was sprayed with 0.25 pound of boron per acre as boric acid in 40 gallons of water on July 26. In view of the tremendous increase in yield which resulted, it was tentatively concluded that boron deficiency was responsible both for the severe shedding and the abnormal vegetative characteristics.

That severe boron deficiency was involved was verified in a greenhouse experiment and in field experiments in 1961 Cotton grown in the greenhouse on a boron deficient soil was stunted, excessively branched, and many of the leaves were distorted. (Figure 3). In earlier stages of growth, severe boron deficiency could be mistaken for thrips injury.

Besides the abnormalities already described, there are other vegetative symptoms which seem to result from boron deficiency. With moderate to severe deficiency, the leaf petioles, in addition to being "banded" may be somewhat enlarged and otherwise distorted, that is, twisted and crooked. On stunted plants, some of the older leaves were thickened and very much larger than normal resulting in a condition that might be described as "leathery leaf" because of the leather-like texture of the leaf as indicated by feel. Such leaves are apt to be very dark green in color. Another symptom of boron deficiency often noted was the deterioration (darkening) of tissue at the base of the boll just above the juncture of the boll with its stem. This may be noted by slicing the boll either in cross-section or longisection which reveals an area of darkened, water soaked tissue.

### Relation of Boron Deficiency to Liming

Liming acid soils increases the need for boron. Consequently, severe boron deficiency is more likely to occur and has been observed much more frequently on limed than on unlimed soils. However, liming even up to pH 7.0 is not likely to produce a severe deficiency except where a moderately severe deficiency exists already. Liming intensified boron deficiency apparently for two reasons; (1) As the soil pH is raised by liming the availability of the soil boron is reduced and (2) with an increase in the calcium content of the plant as a result of liming the boron requirement of the plant may be increased. Farmers should not hestitate to use lime for fear of boron deficiency; rather, it should be recognized that both lime and boron may be needed for maximum yields. The use of boron should not be restricted to limed soils.

### Drought and Boron Deficiency

Boron is not translocated readily from old to new tissue in plants. Therefore, if the cotton plant fails to absorb boron, even for relatively short periods, certain parts of the plant may become deficient. In periods of drought, continuous absorption of boron from the soil may be interrupted or greatly curtailed because (1) plants do not absorb boron efficiency, if at all, from soils depleted of plant-available water and (2) much of the available boron is found in the surface 6-inches where the available water is depleted first because of plant-use and evaporation. If the sub soil does not contain adequate boron, then a deficiency may develop after the surface soil is depleted of available water. During the fruiting period, the first visual evidence of drought-induced boron deficiency is very likely to be excessive shedding of squares, young bolls, and in some cases relatively large bolls. Other symptoms such as leaf-petiole necrosis and ruptured nectaries of squares may also be evident.

Annual fertilization of cotton with boron could reduce markedly the incidence of drought-induced boron deficiency. Should this not be the case, however, then foliar application may be necessary. Additional research is needed in this area before a definite conclusion can be drawn.

### Field Trials With Boron in 1961

As a result of the experiences in the summer of 1960, the research program with boron on cotton was greatly expanded. One series of field experiments had the following objectives: (1) To provide confirmation of boron deficiency in certain cotton fields that were severely affected in 1960; (2) to obtain information as to rate and method of application to soils for most effective results; and (3) to determine if foliar application in addition to soil application of boron is necessary to obtain maximum response to boron.

Experiments were located at the Walter Moore and Rufus Purdy farms in Yalobusha County, at the North Mississippi Pontotoc Ridge-Flatwoods and Brown Loam Branch Stations and at the Central Station, State College. Soils not already heavily limed were heavily limed prior to putting out the boron treatments. Where lime was applied, the rate was twice that indicated by a lime requirement determination. All test sites were fertilized adequately and uniformly with nitrogen, phosphate and potash.

The boron treatments imposed are shown in Table 2. Solubor, a highly water-soluble borate fertilizer, was the source of boron. Before being applied, the Solubor was dissolved in water. Broadcast application was made by spraying the Solubor solution on the soil surface just prior to seed bed preparation. Drill application was made by dribbling the solution in the water furrow with the NPK fertilizer. Foliar application was made by spraying the foliage with a Solubor solution using a compressed-air garden-type sprayer.

Yield results are given in Table 2. A very large increase was obtained for boron both at the Moore farm and the Pontotoc Station, a moderately large increase at the Purdy Farm, a fair increase at both the Central Station and the Brown Loam Station, but only a slight increase at the North Mississippi Staion.

Both broadcast and drill applications of boron were highly effective. A drill application of 0.5 pound was adequate, or more than, even under conditions of severe boron dificiency. On the average, soil plus foliar application gave slightly larger yields than soil application alone, but the evidence is by no means conclusive that foliar application is or is not needed where a soil application is made. Actually, there was little opportunity to measure the need for additional boron as a foliar application in 1961 because soil moisture was adequate, or more than, throughout most of the fruiting period.

Though large increases in yield were obtained in some cases, there was no visual evidence of boron deficiency until late in the growing period. At no time was shedding so severe as it was during the drought periods of 1960. No squares with ruptured nectaries were observed and only under the most severe conditions of deficiency were the petioles "banded". However, a darkened, water-soaked area at the base of the bolls was commonly observed. The appearance of boron deficiency in cotton late in the season on the Moore farm was marked by sparse fruiting, upright condition, and the compact, bushy appearance of the boron-deficient cotton, especially in the upper part of the plant.

In another series of experiments, foliar applications of boron to cotton which had not been fertilized with boron were made during the fruiting period using tractor-mounted spray equipment. Five to six applications of 0.1 pound of boron each as Solubor were made. Results are presented in Table 3. On the average there was an increase in yield for the boron-spray treatment which again suggests that boron is needed for cotton and that foliar spraying is an effective method of application.

In many nitrogen-rates experiments in the Hill Sections relatively high rates of nitrogen have reduced the yield below that obtained with a lower rate particularly, or shallow soils during dry summers. Accordingly, another series of experiments was initiated to determine if the reductions in yields with high rates of nitrogen were caused by boron deficiency. The treatments and the resulting yields are shown in Table 4. These results are inconclusive, but there is a hint that boron deficiency may have been involved in yield reductions with high rates of nitrogen. However, the true relationship must be shown in future experiments.

It has been shown by many investigators that toxicity may result when relatively low rates of water-soluble boron are applied to some crops. Toxicity is more apt to occur when the borate fertilizer is drilled in close proximity to the seed. In view of this possibility, an experiment was conducted to determine how much water soluble borate fertilizer could be applied to cotton without toxic effects, particularly in the seedling stage. The

Table 2.—Yield of cotton on heavily limed soils as affected application of boron

| Location and Soil Type | Pounds of boron/A, method of application, and pounds of seed cotton per acre | | | | | |
|---|---|---|---|---|---|---|
| | None | .5-lbs. Drilled | 1.0-lbs. Drilled | 1.0-lbs. Bdcst[1] | 0.5-lbs. Drilled<br>0.5-lbs. Foliar[2] | 1.0-lbs. Bdcst[1]<br>0.5-lbs. Foliar[2] |
| North Miss. Branch Station Grenada Silt Loam (pH N.D.)[3] | 1520 | 1581 | 1587 | 1497 | 1626 | 1475 |
| Rufus Purdy Farm Unclassified silt loam (pH 6.8) | 1531 | 1807 | 1882 | 1753 | 1927 | 1784 |
| Walter Moore Farm Unclassified silt loam (pH 8.2) | 937 | 1937 | 1816 | 1899 | 2029 | 2032 |
| Central Station Verona Sandy loam (pH 7.0) | 1593 | 1705 | 1796 | 1633 | 1693 | 1945 |
| Pontotoc Branch Station Providence silt loam (pH 7.3) | 1305 | 2271 | 2305 | 2250 | 2025 | 2209 |
| Brown Loam Branch Station Richland silt loam (pH N.D.) | 1246 | 1263 | 1054 | 1297 | 1351 | 1226 |
| Average all locations | 1355 | 1761 | 1740 | 1722 | 1775 | 1779 |

[1] Bdcst = Broadcast; [2] Five foliar sprays of 0.1 lb. of boron each. [3] N.D. = not determined.

Table 3.—Response of cotton to boron applied as a foliar spray during the fruiting period.

| | | Pounds of seed cotton per acre | |
|---|---|---|---|
| Location | Soil type | No Boron spray | Boron spray[1] |
| McFarland Farm | Unclassified silt loam | 2400 | 2435 |
| Shapley Farm | Unclassified silt loam | 1947 | 2036 |
| Black Belt Station | Hunt clay | 1718 | 1726 |
| Central Station | Verona sandy loam | 1493 | 1448 |
| Northeast Miss. Station | Iuka sandy loam | 1418 | 1628 |
| Average | | 1795 | 1855 |

[1] Five to six applications of 0.1 pound of boron each at approximately weekly intervals. Solubor was the source of boron.

Table 4.—Response of cotton to boron as affected by amount of nitrogen applied.

| | Boron treatment, nitrogen rate Lbs./A, pounds of seed cotton per acre | | | |
|---|---|---|---|---|
| Location and | Boron[1] | | No Boron | |
| Soil Type | 80 | 160 | 80 | 160 |
| North Miss. Station<br>Grenada silt loam | 1802 | 1772 | 1806 | 1555 |
| Pontotoc Station<br>Providence silt loam | 2292 | 2221 | 1481 | 1698 |

[1] An application of 0.5 pound of boron as Solubor in drill with NPK Fertilizer prior to planting plus 5 or 6 foliar applications of 0.1 pound each as Solubor at weekly intervals during the fruiting period.

tests was carried out at State College on Verona fine sandy loam. There were three rates of boron; 0.5, 1.0, and 2.0 pounds per acre plus a no-boron check. Placement of borate fertilizer was 2 inches to the side and 2 inches below the seed and in the water-furrow three inches below the seed. Yield data were not taken because of a severe wilt infestation. However, there were no observable toxic effects. Even so, it is recommended that no more than 0.5 pound of water-soluble boron be banded close to the seed.

### Extent of Boron Deficiency

Severe boron deficiency is known to have occurred in 10 counties of the Hill Section, possibly in five others, and in one Delta Foot-Hills County. As a general rule, relatively small, irregularly shaped areas within a field are affected very severely by it, but there may be exceptions particularly during drought periods. Data on the relative available boron status of Mississippi soils are shown in Table 5. Clay soils of the Delta Area contain the largest amounts of available boron and are given a relative rank of 100. Soils of the Hill sections contain considerably less available boron than soils of the Delta Area. It appears that boron deficiency is much less likely to occur in the Delta Area than in the Hill Section.

Because of the possible involvement of drought-induced boron deficiency in the "dry-weather" shedding of cotton, it is difficult to anticipate the degree and extent of boron deficiency in cotton in the Hill Section. It is recognized that cotton sheds for many reasons, and in periods of drought if it does not shed because of boron deficiency it will eventually shed for some other reason.

### Boron Recommended for Cotton in Hill Section

Based on the experimental data available and observations of boron deficiency in farm fields of cotton, it now appears that cotton in the Hill Sections and possibly in the Delta Foot-Hills (especially limed silt and sandy loam soils) should be fertilized annually with boron. This may be done (1) by applying a borated fertilizer, (2) by foliar application perhaps

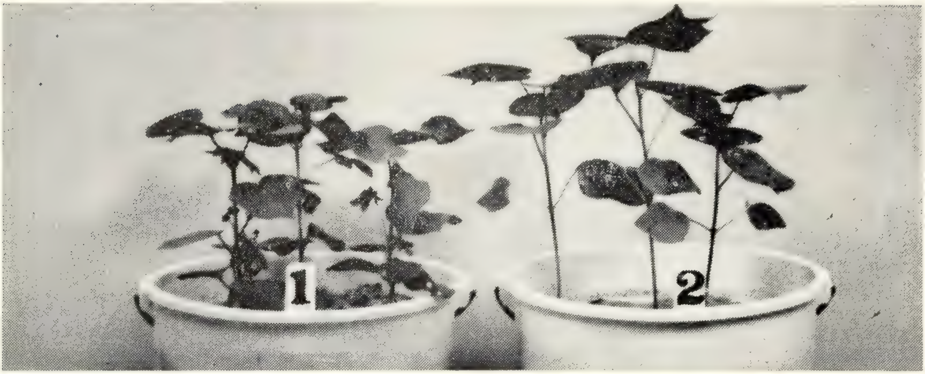

**Figure 3. Cotton in pot 1 was not fertilized with boron; that in pot 2 was. Cotton in pot 1 is stunted, excessively branched and some of the leaves are very much deformed.**

with the insecticide solution at regular intervals during the fruiting period, and (3) by direct application of borate fertilizers to the soil. The use of borated fertilizers provides a very convenient and perhaps the least expensive procedure. For this purpose borated fertilizers having $P_2O_5$ to $K_2O$ ratios of 1:1 and 2:1, as typified by 6-8-8 and 5-10-5, respectively, should contain enough boron to give a per acre application of 0.3 pound of boron when applied at the rate of 48 pounds of $P_2O_5$ per acre, which is the amount of $P_2O_5$ generally recommended for cotton in the Hill Section.

Fertilizers containing this amount of boron would have a $P_2O_5$ to boron ratio of 160:1. Farmers who use as little as 32 pounds of $P_2O_5$ per acre still would apply 0.2 pound of boron per acre which would very probably be adequate except in case of severe deficiency. Farmers who use as much as 60 pounds of $P_2O_5$ would add 0.4 pound of boron per acre. The extra amount of boron would not often be expected to be beneficial, neither would it be expected to be toxic with proper placement of fertilizer. Where fertilizers are banded as recommended with respect to the seed, the rate of water-soluble boron added with the fertilizer should not exceed 0.5 pounds per acre. Larger amounts from slowly-soluble sources may be applied without danger of toxicity. If the borated fertilizer is applied broadcast, as much as 2 pounds of boron per acre may be added without danger of toxicity. Both water-soluble and slowly-soluble (borated slag) sources of boron should be satisfactory for formulation with fertilizers.

Solubor is recommended for foliar spray and for direct application to the soil as a spray. Except possibly in cases of moderate to severe deficiency, 0.5 pound of boron sprayed on the soil should be adequate but up to 2 pounds may be applied without appreciable danger of toxicity. It is probable that the boron can be applied satisfactorily with the premerge herbicide, but this has not been verified. Should this method be employed, the boron-rate should not exceed 0.5 pound per acre in a 12 to 14-inch band.

From 5 to 7 foliar applications of approximately 0.1 pound of boron per acre each at weekly intervals during the fruiting period would be expected to give satisfactory results. Solubor is found to be compatible with all insecticides for cotton, then, a convenient and inexpensive way to make foliar applications would be to dissolve Solubor in the insecticide solution after it is prepared for application and spray them on together. Compatibility tests of Solubor with cotton insecticides have not been completed, but based on

**Table 5.—Relative amounts of available boron in Mississippi soils.**

| | Soil class | | |
|---|---|---|---|
| Soil area | Clays[1] | Silt Loams | Sandy loams |
| Delta | 100 | 52 | 50 |
| Blackland | 59 | — | 56 |
| Loess, Thick and Thin | — | 36 | — |
| Coastal Plain, Upper and Lower | 44 | 33 | 33 |

[1] Delta clays are highest in available boron and are given a relative rank of 100. Data on available boron were supplied by Dr. L. E. Nelson.

**Table 6.—Amounts of Solubor to add per gallon of solution for a foliar application of 0.1 pound of boron per acre.**

| Gallons of solution applied per acre | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| Pounds of Solubor[1] needed per gallon | 0.24 | 0.16 | 0.12 | 0.10 | 0.08 | 0.07 | 0.06 | 0.055 | 0.05 |

[1] Solubor contains 20.5% boron.

their chemical characteristics it is probable that only the organic phosphates would be affected. A schedule of the amounts of Solubor to add per gallon on spray solution is shown in Table 6.

Borate is not strongly retained by soils and like nitrate salts is easily lost by removal in water percolating through the soil. Consequently, there is little danger of an accumulation of toxic amounts of boron from annual applications of recommended rates of boron.

Solutions of Solubor and other borate compounds are non-corrosive to farm equipment used in the application of herbicides and insecticides. These solutions are non-toxic to the skin and are very safe to handle.

Just because a little boron used properly may be highly beneficial farmers should not assume that much more would be even better. To the contrary, toxicity and reduced yields may easily result. This is especially true where water-soluble sources are banded with the fertilizer near the seed.

Fertilizers containing the amount of boron suggested for cotton (0.3 pound of B for each 48 pounds of $P_2O_5$) may be used on other row crops such as corn and grain sorghum without danger of appreciable toxicity but little if any benefit would be expected from the boron. It is recommended that such fertilizers not be applied to small grain particularly if the fertilizer is drilled in contact with or very close to the seed.

### Economics of Boron Fertilization

Large increases in the yield of cotton have been obtained with boron on extremely deficient soils. Fortunately very little of the cotton acreage is severely deficient in boron and a more reasonable expectation would be for yield increases ranging up to 100 pounds per acre. An increase in the yield of less than 5 pounds of seed cotton per acre woud be required to pay for the boron. Therefore, an average increase of only 50 pounds of seed cotton would be quite profitable. For so little cost, it would seem that farmers might want to eliminate the risk of boron deficiency in cotton in the Hill Section.

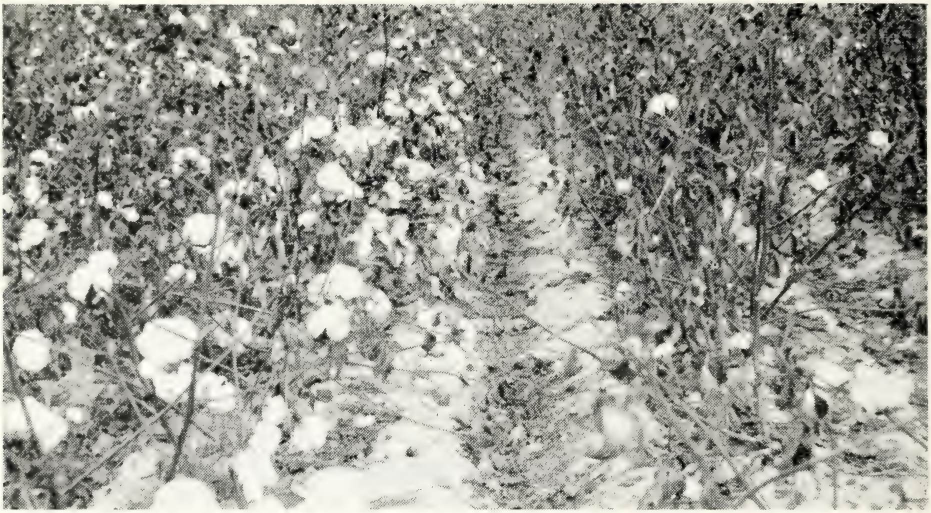

Figure 4. A contrast of boron vs. no boron at the Moore farm, 1961.

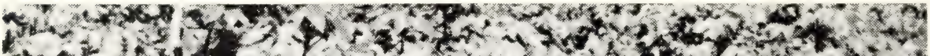

Figure 5. In the foreground is a no-boron check plot at Moore farm, 1961. Note the upright, compact, and sparsely-fruited conditions as opposed cotton in the background pulled over into the middle with bolls.

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BULLETIN 636
FEBRUARY, 1962

# Practices and Preferences of Teen-Age Girls in the Selection of Blouses, Skirts, Dresses and Sweaters

By
Dorothy Dickins and Virginia Ferguson

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Acknowledgments: Thanks are due school superintendents, teachers, and teen-agers for their cooperation in connection with this study. Also, the authors wish to acknowledge their appreciation to Miss Julia Scott of the Home Economics Department of Mississippi State College for Women, and Miss Marguerite O. Davis, Clothing Specialist of the Mississippi Agricultural Extension Service, for reading the manuscript and offering suggestions.

# PRACTICES AND PREFERENCES OF TEEN-AGE GIRLS IN THE SELECTION OF BLOUSES, SKIRTS, DRESSES, AND SWEATERS

By

Dorothy Dickins and Virginia Ferguson*

## INTRODUCTION

The teen-age girl is a "high clothing spender". Little is known about her satisfaction and dissatisfaction with the outer garments she has. Basic information is needed regarding features she considers desirable and undesirable about cotton and other fabrics in specified garments. Such information is important to persons who assist in educational programs as well as to producers, retailers, and manufacturers. Satisfactions with textile goods available in the market have particular economic implications in the South. In addition, clothing satisfactory to the teenager contributes to her feeling of adequacy and hence to her adjustment in the family and in society.

The objectives of this study were to determine: (a) Kinds, amounts, and uses of selected outer garments owned by teen-age girls, by place of residence, race, social participation, and related factors; (b) Preferences for fibers in selected garments; and (c) Marketing factors affecting type and kinds of garments owned.

## SCOPE AND METHODS

A sampling plan was developed to yield data from approximately 1200 girls. This plan was based on the number of white and Negro high school girls in urban and rural high schools of the State. There were twice as many girls in urban as in rural high schools.

Counties selected for the study were: Bolivar, Choctaw, Hancock, Hinds, Jones and Lee. Four schools in each county were selected for the study. These included two schools located in urban areas, one for white and one for Negro students; and two schools located in rural areas, one for white and one for Negro students. There were three exceptions to this: (a) In Choctaw County where there was no city of 2500 or more inhabitants, only children in rural schools were taken; (b) In Hancock County girls in two Catholic schools as well as in two public schools were included in the urban samples. As there is no high school located in the rural areas of this county for Negro children, none is included in the rural sample; (c) Due to the fact that the number of schedules from white girls in urban schools obtained in Bolivar County was less than expected, eleventh grade girls in the Clarksdale High School were added. The names of the high schools included in the study are given in Appendix, Section I.

Girls in the eleventh grade in each of the 24 schools were included. In a few of these schools where there were fewer participants than had been estimated, girls in the twelfth grade were added.[1]

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[1] Some girls in the 10th grade were also included due to the fact that they were in the same home room where tests were given to 11th grade girls. It was thought that giving tests to all in the room would result in more accurate data.

*Now a Graduate Student at the New York State College of Home Economics at Cornell.

A member of the Home Economics staff of the Mississippi Agricultural Experiment Station met with the girls at the schools and presented the purpose of the study. She passed around a sheet numbered consecutively on which girls recorded their names. She instructed the girls to use the number by which their name was recorded on all forms. No names appeared on the forms. She had them fill out the first schedule, explaining each question.

Inventory sheets (Schedule II) concerning number of dresses, blouses, skirts, and sweaters owned and fiber of which they were made were given girls to be filled out at home by wardrobe count.

The third and final schedule was filled out several days later at the school under the direction of the member of the Mississippi Agricultural Experiment Station staff who had assisted the girls with their first schedule. This third schedule sought information concerning specified garments on the inventory sheet.

Collection of data was started in October 1959 and completed in May 1960. The forms filled out were as follows:

| Forms filled out | No. Girls |
|---|---|
| All 3 | 1029 |
| 1st only | 128 |
| 1st and 2nd | 13 |
| 1st and 3rd | 50 |
| Total | 1220 |

## DESCRIPTION OF GIRLS

### Race, Residence, Age, Schooling

One or more schedules were filled out by 289 white girls living in rural areas and 551 white girls living in urban areas; by 163 Negro girls living in rural areas and 217 Negro girls living in urban areas.[2] Median age of both rural and urban white girls was 16 years; of both rural and urban Negro girls, 17 years. About three-fourths of the girls were either 16 or 17 years of age. Seventy-two percent of the girls were in the 11th grade, 19 percent in the 12th grade, and 9 percent in the 10th grade.

### Their Families

The principal occupation of the main earner varied among the four groups. More white girls (both rural and urban) reported occupation classified as "skilled laborer" (36 and 31 percent respectively). More rural Negro girls reported "farmer" (51 percent) and more urban Negro girls reported occupation in the category "unskilled laborer" (53 percent). "Professional worker, business owner, executive" was second in importance as a main occupation in families of white urban girls as was farming in families of white rural girls. Skilled laborer ranked second in importance as a main occupation of families of Negro urban girls while unskilled laborer ranked second as a main occupation of families of Negro rural girls.

The median number of members in households of white rural girls was 5; in households of white urban girls, 4; in households of Negro rural girls, 7; and households of Negro urban girls, 6.

When asked about sisters in high school the following percentages of girls reported having one and more than one:

| Group | One sister* | More than one sister* |
|---|---|---|
| White rural | 17 | 3 |
| White urban | 10 | 1 |
| Negro rural | 27 | 11 |
| Negro urban | 27 | 6 |

*Sisters in Junior High not included.

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[2] Some rural girls attended urban schools.

### Home Activities in Connection with Clothing

Washing and ironing their clothes was a regular activity for the majority of Negro girls but not for the majority of white girls. Ironing and pressing clothes was more often done by both groups than was washing of clothing.

The percentage of girls in the four groups reporting they had made one or more dresses for themselves during the past year was as follows:

| Group | Percent |
|---|---|
| White rural | 47 |
| White urban | 37 |
| Negro rural | 67 |
| Negro urban | 57 |

Fifty-one percent of the white rural girls and 41 percent of the Negro rural girls reported in addition that they had made clothing other than dresses for themselves during the past year. The percentage of urban white and Negro girls so reporting was 42 and 43 respectively.

### Clothing Instruction in School and 4-H Club

Every girl was asked, "Have you taken home economics in school? Yes__ No__. If Yes, number of years including this year." The girl was told to count home economics taken in Junior High as well as Senior High. There is some work done in clothing during the first year of home economics; so, if the girl had had home economics she had had some work in clothing. The percentage of girls having had home economics was high in all groups. It was as follows:

| Group | Percent having had Home Economics |
|---|---|
| White rural | 94 |
| White urban | 84 |
| Negro rural | 89 |
| Negro urban | 96 |

White girls who had taken home economics had had a median of two years; Negro girls, three years.

About three-fourths of the white and Negro rural girls had been members of a 4-H club at one time or another. Only one-third of the urban girls had been members. Of those rural white girls who had been members, 79 percent had worked on a clothing project; of those urban white girls who had been members, 84 percent had worked on a clothing project. The percentage of rural and urban Negro girls who had been members of the 4-H club and who had worked on a clothing project was 61 and 70 respectively. Clothing projects seemed to be relatively more attractive to urban girls.

### Attitudes of Girls About Clothes

Each girl was asked two questions to determine how well dressed she thought herself to be. These were: (1) Think of the way your special friends usually dress. Would you say that you dress not as well as they do, better than they do, or about the same as they do? (2) Think of the way most of the girls in this high school dress. Would you say that you dress not as well as they do, better than they do, or about the same as they do? About 94 percent of the girls thought they dressed about the same as their friends and about 90 percent thought they dressed about the same as most girls in school. There was little difference in attitudes of the girls in the four groups. This seems to be a very healthy attitude on the part of these teen-agers.

To get the girl's evaluation of her knowledge about clothes, the following two questions were asked: (1) When it comes to

FIGURE I. The Way Girls in the Four Groups Describe Themselves When it Comes to Knowing About Clothes, Styles, and Fibers.

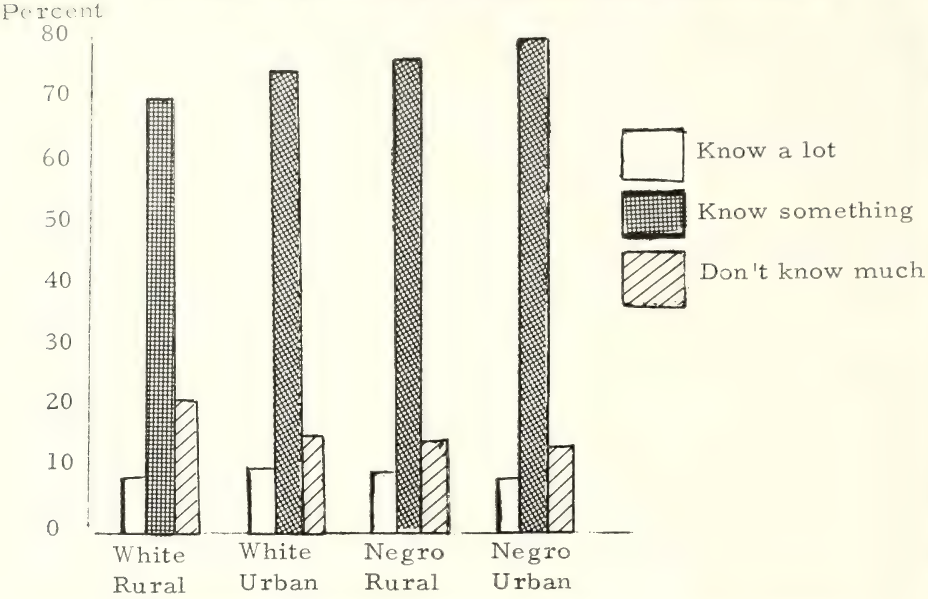
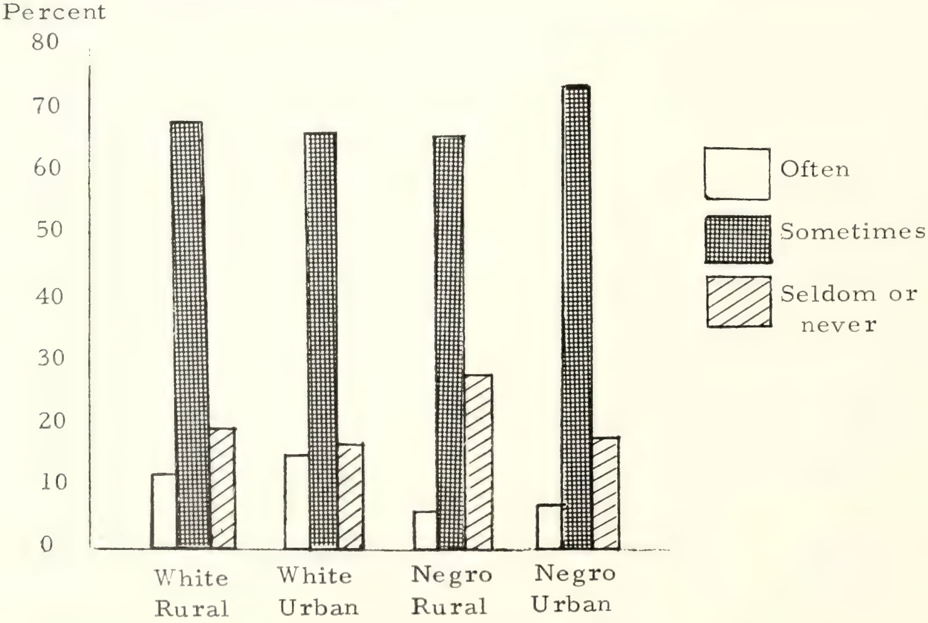


FIGURE II. Frequency Friends Comes to Girls in the Four Groups for Advice on Clothing.



"knowing" clothes, styles, and materials, how would you describe yourself: I know a lot about clothes; I know something about clothes; or I don't know too much about clothes; (2) Do your friends come to you for advice on their clothes: Often, sometimes, seldom or never.

About three-fourths of the girls in all four groups said they knew "something about clothes". Replies as to frequency of friends coming to them for advice about clothes were somewhat similar. Two-thirds in all groups except urban Negroes said friends consulted with them "sometimes". Three-fourths of the Negro urban girls said friends consulted with them "sometimes". More reported they didn't know much and that friends seldom or never came to them for advice than reported they knew a lot and that friends often came to them for advice. (See figures 1 and 2).

## KNOWLEDGE OF FIBER CONTENT

Every girl participating in filling out Schedule I was given a set of samples to determine her ability to judge fiber content.[3] Samples were about 5 by 7 inches attached to a card and numbered. Girls were encouraged to feel the material between their fingers. Enough material was purchased to replace samples as they got dirty from handling. A chart appeared in the schedule with 10 possibilities for fiber content: all silk, all nylon, all cotton, all wool, all linen, all orlon, all rayon or acetate, all dacron, all acrilan, and a blend of one or more of these fibers (name the fibers). A description of the 8 sample fabrics used in the study is given in Section II of the Appendix. Samples 1 and 5 were blue organdy; sample 2 was red velvet and sample 6 was red velveteen.

The percentage of girls correctly identifying each of the 8 samples was as follows:

| Description of sample | Percent correctly identifying |
|---|---|
| (1) Cotton organdy | 17 |
| (2) Rayon velvet | 10 |
| (3) Cotton glazed print | 78 |
| (4) Dacron cotton print | 2 |
| (5) Nylon organdy | 60 |
| (6) Cotton velveteen | 12 |
| (7) Cotton corduroy | 28 |
| (8) Orlon and wool blend | 3 |

More of the girls correctly identified the glazed cotton print and nylon organdy; fewer identified fabrics of two fibers (dacron-cotton and orlon-wool). Seventy percent, however, called the dacron-cotton print, "cotton", and 75 percent called the orlon-wool blend, "wool".

In the case of the cotton organdy, the rayon velvet, the cotton velveteen, and cotton corduroy we got 9 percent, 32 percent, 22 percent and 29 percent fabric replies, such as organdy, velvet, velveteen, corduroy respectively. In other words, there were girls who did not distinguish between fiber and fabric. There was a wide variation in replies about the cotton organdy sample. From 7 to 17 percent of the girls identified this sample as being all cotton, all linen, orlon, rayon, dacron, or a blend of fibers.

Table 1 shows the percentage of girls in the four groups by the number of samples they correctly identified as to fiber content. The majority (86 percent) identified less than one-half the samples correctly. This included the one percent giving no report.

---

[3] Fabrics and fibers selected were those commonly used in wardrobes of teenagers.

Table 1. Percentage of girls in the four groups classified by number of samples they correctly identified as to fiber content.

| Group | Number Samples | | | | | | | | | | Total Girls |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | None | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | No Report | No. |
| White rural | 7 | 23 | 35 | 18 | 11 | 3 | 2 | * | 0 | 1 | 289 |
| White urban | 6 | 27 | 34 | 18 | 10 | 4 | 1 | 0 | 0 | * | 551 |
| Negro rural | 7 | 25 | 38 | 18 | 9 | 1 | 1 | 0 | 0 | 1 | 163 |
| Negro urban | 6 | 26 | 43 | 15 | 7 | 2 | 0 | 0 | 0 | 1 | 217 |
| Average | 6 | 26 | 36 | 17 | 10 | 3 | 1 | * | 0 | 1 | 1220 |

*Less than .5 percent

Until March 3, 1960, three months before the field work of this study was completed, only wool products and furs among textile products were required by law to carry proper descriptive labels. In the absence of regulations many labels were used which carried misleading implications for consumers. The Textile Fiber Products Identification Act which went into effect March 3, 1960, required that the relative proportion up to 5% or more of the fiber be indicated. Relatively speaking, the field of synthetic fibers is still in the early stages of development. The number of potential chemical constructions is virtually unlimited. At the present stage of development, consumers (including teen-age consumers) cannot be expected to identify correctly some of these fibers. On the other hand, one might expect that a larger percentage of the teen-agers would have recognized cotton in materials which many use, such as organdy, velveteen, corduroy.

## SHOPPING FOR CLOTHES

All girls were asked how often they were allowed to buy the clothes they would like, and a little more than four-tenths said, "almost all the time". A little more than three-tenths stated, "much of the time", and a little more than two-tenths said, "once in a while". Percentages in the four groups giving these replies were about the same. Very few said they were "seldom or never" allowed to buy the clothes they wanted.

Girls were asked who usually made decisions about whether to buy most of their clothes, and at what age they thought a girl was old enough to do her shopping and pick out her clothes. (See Tables 1 and 2 in Appendix). The following percentage said they themselves usually made the decisions:

| | |
|---|---|
| White rural | 73 |
| White urban | 74 |
| Negro rural | 68 |
| Negro urban | 57 |

The Negro girls more often reported that their mothers made the decisions than did the white girls. All groups most frequently picked 15-16 years as the age a girl is old enough to do her own shopping and pick out her own clothes. Those who did not mention 15-16 years usually mentioned 13-14 years.

In Schedule I girls were asked: **In the past year** have you bought any clothes (or material to make clothes) and paid for them yourself with your own money or money given to you? Only 13 percent checked "No". Those who had checked "Yes" were asked to think of the **last** thing they bought ready-made or materials to make. Was it: (Check one or more, if bought more than one on the same day): A ready-made dress___ A ready-made blouse___ A ready-made skirt___ A ready-made sweater___ Something else ready-made___ What?___ Material to make something___ What?___.

The following stated that when they last purchased something with their own money or money given to them they had bought the following:

| Item | Percent* |
|---|---|
| A ready-made dress | 26 |
| A ready-made skirt | 30 |
| A ready-made blouse | 18 |
| A ready-made sweater | 31 |
| Something else ready made | 15 |
| Material to make something | 30 |

*Percentages total more than 100 as the last purchase was often of more than one item.

Table 2 shows the way the girls got the money to buy the items of clothing reported bought during the past year. Most of the girls were either given the money especially to buy the items wanted, or used money they had earned. The percentage of Negro urban girls using money they had earned was considerably higher than for the other three groups.

**Table 2. Way girl obtained money to purchase last items of clothing bought.**

| Group | Took from allowance | Parents gave to buy this | Took from money earned | Someone outside family gave | Other as took from savings | More than one way | No report | Did not buy | Total Girls |
|---|---|---|---|---|---|---|---|---|---|
| | Percent | | | | | | | | No. |
| White rural | 8 | 43 | 29 | 2 | 2 | 1 | * | 14 | 289 |
| White urban | 11 | 32 | 30 | 5 | 4 | 3 | * | 14 | 551 |
| Negro rural | 6 | 48 | 26 | 4 | 0 | 4 | 1 | 11 | 163 |
| Negro urban | 6 | 38 | 42 | 2 | * | 3 | * | 9 | 217 |
| Average | 9 | 38 | 31 | 4 | 2 | 3 | * | 13 | 1220 |

*Less than .5 percent

## IMPORTANT FEATURES IN CLOTHING

Girls were asked to check things important to them in the clothes they wear. Fit, becomingness, and color were the three features checked by most girls in all four groups. (Table 3 in Appendix). The fiber and the weave were checked by fewest girls in all groups. Fit was checked by relatively more in all four groups than was becomingness and color.

When asked to check the **most important** feature, most girls in all four groups checked "fit" (Table 3). Color was of first importance to about one-third of the Negro girls; becomingness, to nearly a

**Table 3. The features checked as most important in clothing they wear, by white and Negro rural and urban girls.**

| Group | Color | Fit | In fashion | Weave | Fiber | Becoming ness | No report | Total Girls |
|---|---|---|---|---|---|---|---|---|
| | Percent | | | | | | | No. |
| White rural | 9 | 56 | 6 | 0 | 2 | 27 | 0 | 289 |
| White urban | 5 | 53 | 7 | 0 | 1 | 33 | 1 | 551 |
| Negro rural | 37 | 43 | 7 | 1 | 1 | 9 | 3 | 163 |
| Negro urban | 28 | 43 | 2 | 1 | 2 | 23 | 2 | 217 |
| Average | 14 | 51 | 6 | * | 1 | 26 | 1 | 1220 |

*Less than .5 percent

third of the white girls. While becomingness was more important to Negro urban than to Negro rural girls, color was more important to Negro rural than to Negro urban girls.

## PRACTICES AND PREFERENCES REGARDING CLOTHING

All girls were asked about the clothes they liked best to wear to school, Sunday School or church, and to dress-up parties in cold and warm weather — whether skirts and blouses, skirts and sweaters, or dresses. In the first draft of the schedule, during pre-testing, the term parties rather than dress-up parties was used. A number stated they wore "blue jeans" to parties. In revising the schedule for use in the study it was decided to limit the question to the dress-up type of party. One hundred and fifty-two girls or about 13 percent stated they never went to dress-up parties.[4]

Both white and Negro girls liked skirts and sweaters best to wear to school in cold weather. In warm weather dresses or skirts and blouses were favored about equally by white girls for school. Negro girls, however, favored skirts and blouses over dresses for school in warm weather (see Table 4 in Appendix).

Dresses were preferred in both cold and warm weather by girls in all four groups for wear to Sunday School or church and to dress-up parties. However, there was a considerable number in all groups who preferred skirts and sweaters for these occasions in cold weather. Also, a number of Negro girls stated they preferred blouses and skirts for these occasions in warm weather (see Table 4 in Appendix).

When asked about the **fiber** they liked best for specified garments for school in cold weather all groups expressed preference for wool skirts, cotton blouses, orlon sweaters. White girls expressed preference for cotton dresses and Negro girls for wool dresses for school in cold weather. Fiber preference for skirts, blouses, and dresses for school in warm weather was, in all cases, for cotton. (See Appendix Tables 5, 6, 7 and 8).

When asked about the fiber they liked best for specified garments for Sunday School or church, girls most often named fibers which were similar to those named in connection with these types of garments for school. There was one exception — all groups named wool dresses for Sunday School or church more often than they did cotton dresses, but a higher percentage of Negro than white girls named wool dresses. Only two girls, one rural and one urban white, reported they never went to Sunday School or church.

Fibers preferred for the four types of garments to wear to dress-up parties were also similar to those in garments preferred for school and Sunday School or church. One exception was for dress-up parties in cold weather, especially in the white rural and urban groups. Here we had many non-fiber replies, such as velveteen, velvet, taffeta, chiffon. (See Table 5 in Appendix for fiber preferences of four groups of girls).

On the first schedule the girls were asked not only about preferences in outer garments and fiber content but also about garments and fiber content of the garments they had on (whether a sweater, skirt, blouse, or dress), had worn last time they went to Sunday School or church, and had worn the last time they went to a dress-up party. It might be well at this point to compare what they said they preferred with what they actually wore.

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[4] This included 14 percent of the rural whites, 7 percent of the urban whites, 22 percent of the rural Negroes, and 16 percent of the urban Negroes.

There was close agreement in what the girls said they liked best to wear to school and what they had on at the time of the first interview. Likewise, a close agreement was found in what they said they wore the last time they went to Sunday School or Church and the last time they went to a dress-up party and what they said they preferred. In other words, the girls prefer what they wear, or what they think they wear.

## INVENTORY OF GARMENTS OWNED

After the girls had filled out Schedule I they were given inventory blanks on which to list the dresses, blouses, skirts, and sweaters they owned. They were instructed to take these blanks home, fill them out by wardrobe count, and return them to the representative of the Experiment Station who would meet with them again at the school. There was a blank for each of the four outer garments being studied (dresses, blouses, skirts, and sweaters). These blanks asked for (1) a description of each garment owned; as, for example, plaid skirt, white short-sleeved blouse; (2) the fiber of each garment, whether all cotton, all man-made fiber (nylon, rayon, orlon, etc.), all wool, all linen, all silk, or a blend of one or more fibers (if blend, name the fibers). Each inventory form stated that those garments shared with others should be recorded.

Of the 1220 girls included, 178 did not return inventories. Relatively more rural than urban girls returned inventories. There were many extra curricula activities going on, especially in urban schools. Then, too, the study was more of a novelty in rural schools. Thirty-nine girls turned in incomplete inventories. Thirteen who were ill or who, for other reasons, were not at school during the second visit, returned their inventories through friends.

**Table 4. Number of blouses owned by white and Negro rural and urban girls.**

| Group | Number Blouses | | | | Total* Girls |
|---|---|---|---|---|---|
| | Less than 10 | 10 - 19 | 20 - 29 | 30 and over | |
| | Percent | | | | No. |
| White rural | 13 | 53 | 28 | 6 | 232 |
| White urban | 9 | 45 | 32 | 14 | 424 |
| Negro rural | 37 | 53 | 8 | 2 | 153 |
| Negro urban | 22 | 52 | 22 | 4 | 194 |
| Average | 17 | 50 | 25 | 8 | 1003 |

*Two hundred and seventeen did not turn in an inventory or turned in an incomplete inventory.

### Blouses

Girls in all four groups most frequently owned from 10 - 19 blouses. White girls owned more blouses than Negro girls and urban girls more than rural girls. The white urban girl had most blouses; the Negro rural girl the least (Table 4).

Only 5 of the 1003 who turned in complete inventories on blouses did not own a blouse. One girl owned 82 blouses, but these were shared with others in the family. The following reported that they shared blouses with other girls, their mother, or both:

| | Percent sharing* |
|---|---|
| White rural | 27.5 |
| White urban | 27.9 |
| Negro rural | 26.5 |
| Negro urban | 22.5 |

*This is a report from 990 girls and excludes those not turning in an inventory or complete inventory, as well as the 13 girls returning a complete inventory but not Schedule III on which data about sharing garments were recorded.

Sharing garments with others meant that someone else in the family could wear the garment without asking permission. Nearly three-fourths of the girls sharing blouses with another shared them with one other person. About one-fifth shared them with two other persons. The remainder shared them with 3 persons or more.

Sixty-four percent of those sharing blouses with others shared from 1 - 9 blouses; 14 percent, 10 - 19 blouses; and 9 percent, 20 or more blouses. Thirteen percent did not report the number shared. Only 19 percent of those sharing blouses shared all blouses. The pattern was to share certain blouses, but not all of them.

Only five girls did not have a cotton blouse and these were the girls who did not own a blouse. This means, in brief, that if girls have blouses they usually have cotton blouses. Man-made fibers were next in importance in blouses owned by all four of these groups of teen-agers (See Table 11 in Appendix). About one-half had one or more blouses of man-made fiber. One-eighth reported wool; one-eighth, linen; and one-third, silk blouses in their inventory. It seems likely, in view of the fiber tests given the girls that some of the blouses which were classified as cotton in the inventories were blends of man-made fibers with cotton. About one-fifth of the girls reported having blouses of blends of one or more fibers. One in five reported the fiber in one or more blouses as "unknown" or gave no report on the fiber. Only one-tenth gave fabric rather than fiber replies on one or more blouses listed.[5]

At the time the inventory blanks were given the girls they were told when they would be expected to fill them out and return them. On this day they met again at school with the representative from the Home Economics Department of the Experiment Station, who passed out the third and last form (Schedule III) to be filled out. This form pertained to their favorite blouse, skirt, sweater, and dress, and the one they liked least on the inventory. "Favorite" was defined as the one you would keep if you had to give all you had away except one. The one liked least was defined as the one you would give away if you had to give away only one.

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[5] When a fiber reply was desired, examples were given such as cotton, wool, linen. However, on the inventory pages, the question read, "What material is it? Check one." Columns to be checked were as follows: All cotton; all man-made fiber; all linen; all silk; or a blend of one or more fibers. (Name the fibers). The term 'material' is used by a number of girls to indicate either fiber or fabric.

One hundred and twenty-eight girls did not give information on their favorite blouse and the blouse they liked least nor any information concerning the blouse bought most recently. The 13 girls who returned their inventories through friends also did not give this information. This makes 141 of the 1220 not furnishing these data.

About three-fourths of the blouses named as favorites by girls in all four groups were cotton blouses. About one-tenth were of man-made fibers such as nylon and rayon. These were the kinds of blouses most often found in inventories of these teen-agers.

The features most frequently mentioned in connection with their favorite blouse were:[6] (1) the style, cut or trimming; (2) the color, and (3) the fit. The greatest difference in the four groups was in the percentage naming color. More Negro than white girls mentioned color, especially Negro rural girls as compared with white rural girls. Few in any of the four groups mentioned the fiber or fabric.

About three-fourths of the blouses liked least by white teenagers were cotton; about two-thirds liked least by Negro teenagers were of this fiber. Negro girls named somewhat more man-made fiber blouses as the one they liked least than did the white girls.

The big difference in blouses liked best and least was in the person who selected it. About two-thirds of the blouses liked most had been picked out by the girls themselves; only about one-third of the blouses liked least had been picked out by the girls themselves.

Qualities disliked about the blouse favored least were similar to qualities in the most popular blouse. What the girls didn't like about the blouse in order of importance was (1) style, cut, or trimming; (2) color; and (3) fit. Here, too, color was mentioned more by Negro than white girls as a feature not liked about blouse liked least.

Nine hundred and ninety-four girls reported on their newest blouse.[7] About three-fourths of these blouses had been purchased within the past 3 months. Ninety percent were purchased ready-made; median price paid was $4; about 80 percent were cotton; and about three-fourths had been bought in a store in the county where the girl attended school. Only 5 percent had been purchased by mail order. Sixth-tenths of the girls had picked out the last blouse bought themselves.

The last question on Schedule III, pertained to the qualities which the girl thought blouses, skirts, sweaters and dresses of different fibers had. Each girl was questioned about only one type of garment. Two hundred and sixty-four gave information on blouses. The following number said they had worn at one time or another:

| | No. who had worn |
|---|---|
| A cotton blouse | 262 |
| A nylon blouse | 217 |
| A rayon blouse | 167 |

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[6] Questions concerning what the girls liked most about their favorite blouse, skirt, dress, and sweater, and what they disliked about the particular one of these garments they liked least were of the "open-end" type. Content analyses were later made of the replies.

[7] Under last blouse bought several girls listed a number bought on one day. These were told to tell about only one bought. When they did not follow these instructions and told about several, the first one mentioned was used.

**Table 5. Specified qualities which 264 teen-agers thought cotton, rayon, and nylon blouses had.**

| Qualities | Most cotton blouses have these qualities | Most rayon blouses have these qualities | Most nylon blouses have these qualities |
|---|---|---|---|
| | | Percent | |
| Hold their shape | 94 | 31 | 42 |
| Won't shrink | 74 | 28 | 41 |
| Won't fade | 40 | 33 | 50 |
| Real shiny | 9 | 42 | 38 |
| Gives warmth | 53 | 25 | 37 |
| Cool | 70 | 35 | 40 |
| Doesn't pick up dirt easily | 38 | 31 | 35 |
| Doesn't wrinkle easily | 26 | 35 | 59 |
| Will wear a long time; strong and durable | 83 | 30 | 30 |
| Easily washed | 82 | 39 | 64 |
| Require little or no ironing | 23 | 41 | 73 |
| Feels good to the skin | 78 | 38 | 48 |

These 264 girls were asked to check the qualities they thought most cotton, most rayon, and most nylon blouses had. As will be noted (Table 5) one-half or more of the girls said: most cotton blouses hold their shape; won't shrink; give warmth; are cool; will wear a long time; are easily washed; and feel good to the skin.

Three qualities were named by 50 percent or more in connection with nylon blouses. These were: don't wrinkle easily; are easily washed; require little or no ironing.[8] No quality was named for rayon blouses by as many as 50 percent of the girls.

### Skirts

The majority of girls in all four groups owned from 10 - 19 skirts. Patterns of ownership of skirts of the Negro urban girl were similar to those of the two white groups rather than of the Negro rural girl (Table 6). All girls showed skirts in their inventories. The smallest number of skirts owned was three and this was by four Negro girls — two rural and two urban.

Sharing skirts with others was not quite as common as sharing blouses with others. About three-fourths of the girls sharing skirts with another shared them with one other person. About one-sixth shared them with two other persons. The remainder shared them with 3 persons or more.

Sixty-three percent of those sharing skirts with others shared from one to nine skirts, 17 percent shared 10 - 19 skirts, and 7 percent shared 20 or more skirts. Thirteen percent did not report the number shared. One-fourth of those sharing skirts shared all skirts; three-fourths shared some skirts.

The following reported that they shared skirts with other girls, their mother or both:

| | Percent sharing* |
|---|---|
| White rural | 21.8 |
| White urban | 17.9 |
| Negro rural | 20.4 |
| Negro urban | 17.3 |

*A report from 990 girls. See explanation in connection with sharing blouses.

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[8] A new chemical finishing process devised by USDA scientists to give cotton improved wash-wear characteristics is currently under evaluation by the textile finishing industry. This new process uses formaldehyde to bind together cotton's cellulose molecules. Fabrics given the finish in pilot-plant tests rated high (4 plus or 5) in the standard wash-wear rating scale of 1 through 5.

**Table 6. Number of skirts owned by white and Negro rural and urban girls.**

| Group | Number Skirts: Less than 10 | 10 - 19 | 20 - 29 | 30 and over | Total* Girls |
|---|---|---|---|---|---|
| | Percent | | | | No. |
| White rural | 8 | 55 | 34 | 3 | 232 |
| White urban | 7 | 56 | 29 | 8 | 424 |
| Negro rural | 24 | 57 | 15 | 4 | 153 |
| Negro urban | 9 | 47 | 34 | 10 | 194 |
| Average | 10 | 54 | 29 | 7 | 1003 |

*Two hundred and seventeen did not turn in an inventory or turned in an incomplete inventory.

Only 37 girls did not own a cotton skirt. Nineteen of these were white urban; 9, Negro rural; 5, Negro urban; 4, white rural (Table 9 in Appendix). Nearly three-fourths of the group owned 1 - 9 cotton skirts; nearly one-fourth, 10 - 19 cotton skirts.

Girls owned about the same number of wool as cotton skirts. There were only 24 girls who did not own a wool skirt. Three-fourths owned from 1 - 9 wool skirts and a little more than one-fifth owned 10 - 19 wool skirts. Skirts of other materials were owned by relatively few girls. Inventories reported by about two-thirds of the girls had no skirt of man-made fiber, linen, or of a blend of fibers. About one-third reported the fiber in one or more skirts as "unknown" or gave no report on fiber. About 40 percent gave a fabric rather than a fiber reply in one or more skirts they owned. These replies included fabrics such as corduroy, gabardine, taffeta.

On Schedule III the girls were asked about their favorite skirt and the one they liked least. There were 1079 girls who furnished information about these particular skirts. About two-thirds of the skirts named as favorite by girls in all four groups were wool skirts, and about one-sixth were cotton skirts.

The things liked about this favorite skirt were in order of importance: (1) the fit; (2) the color; (3) the style, cut, or trimming. More Negro than white girls mentioned color, especially rural Negro girls. Only 5 percent mentioned fiber or fabric.

Thirty-five percent of the skirts liked least were cotton; 33 percent were wool. The big difference in skirts liked best and least was in the person who picked it out. Seventy percent of the girls themselves had picked out their favorite skirt, but only 37 percent had picked out the skirt they liked least.

Qualities disliked about the skirt favored least were similar to qualities in the most popular skirt. What girls disliked about these skirts were in order of importance: (1) the fit; (2) color; (3) style, cut, or trimming. Here, too, color was mentioned more by Negro than white girls as a feature not liked about skirt liked least.

Nine hundred and eighty girls reported on their newest skirt.[9] About three-fourths of these had been purchased within the past three months. Ninety percent were purchased ready-made with a median price of $6. Fifty-six percent of these were wool skirts and 21 percent were cotton skirts. About

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[9] See footnote 7. The same procedure was followed for skirts as for blouses.

**Table 7. Specified qualities which 275 teen-agers thought cotton, wool and rayon skirts had.**

| Qualities | Most cotton skirts have these qualities | Most wool skirts have these qualities | Most rayon skirts have these qualities |
|---|---|---|---|
| | | Percent | |
| Hold their shape | 83 | 57 | 21 |
| Won't shrink | 69 | 46 | 20 |
| Won't fade | 35 | 75 | 21 |
| Real shiny | 12 | 6 | 44 |
| Gives warmth | 19 | 95 | 14 |
| Cool | 79 | 4 | 22 |
| Doesn't pick up dirt easily | 43 | 51 | 25 |
| Doesn't wrinkle easily | 22 | 81 | 16 |
| Will wear a long time; strong and durable | 60 | 84 | 21 |
| Easily washed | 94 | 3 | 13 |
| Require little or no ironing | 25 | 37 | 23 |
| Feels good to the skin | 77 | 28 | 33 |

three-fourths of these skirts had been bought in a store in the county where the girl attended school. Only 4 percent had been purchased by mail order. Sixty-three percent of the girls themselves had picked out the last skirt bought.

Two hundred and seventy-five girls were questioned about qualities they thought skirts of specified fibers had. The following number said they had worn at one time or another:

| | No. who had worn |
|---|---|
| A cotton skirt | 274 |
| A wool skirt | 270 |
| A rayon skirt | 83 |

The 275 girls were asked to check the qualities they thought most cotton, most wool, and most rayon skirts had. As will be noted (Table 7), one-half or more of the girls said: most cotton skirts hold their shape; won't shrink; are cool; will wear a long time; are easily washed; and feel good to the skin.

When asked about wool skirts 50 percent or more of the girls mentioned the following six qualities; will hold shape; won't fade; give warmth; don't pick up dirt easily; don't wrinkle easily; will wear a long time. No one quality for rayon skirts was mentioned by 50 percent or more of the girls.

### Dresses

From 45 to 55 percent of the girls in the four groups owned from 10 - 19 dresses (Table 8). The fewest dresses owned by those who turned in complete inventories were two. Four girls had this number.

The following reported that they shared dresses with other girls, their mother or both:

| | Percent sharing* |
|---|---|
| White rural | 14.4 |
| White urban | 10.7 |
| Negro rural | 11.3 |
| Negro urban | 11.0 |

*A report from 990 girls. See explanation in connection with sharing blouses.

About three-fourths of the girls sharing dresses with another shared them with one other person. About one-fifth shared them with two other persons. The remainder shared them with 3 persons or more. Dresses were shared less with others than were blouses and skirts.

Sixty percent of those sharing dresses with others shared from 1 - 9 dresses; 12 percent, 10 - 19 dresses; 9 percent, 20 or more dresses. Nineteen percent did not report the number shared. Only 26 percent of those sharing dresses shared all dresses.

More than half of the girls (57 percent) owned 1 - 9 cotton dresses and more than one-third (34 percent) owned 10 - 19 cotton dresses (Table 9 in Appendix). Only 18 girls did not have a cotton dress. About two-thirds of the girls owned one or more dresses of man-made fiber and of all wool. Dresses of other types of fiber (linen, silk, blends of two or more) were reported by less than half the group. About one-third reported the fiber in one or more dresses as "unknown" or gave no report of the fiber. About the same proportion gave fabric rather than fiber replies on one or more dresses listed.

The girls' favorite dress, "the one you would keep if you had to give all you had away except one", was cotton in 46 percent of the cases, wool in 13 percent of the cases, and a man-made fiber in 13 percent. About two-thirds of the girls (69 percent) in all groups had picked out this favorite dress themselves. Only thirty-nine percent of the girls had picked out the dress liked least.

The things liked about the favorite dress were in order of importance: (1) style, cut, or trimming; (2) color; (3) fit. The greatest difference in the four groups was in the percentage naming color. More Negro than white girls mentioned color. Only 6 percent men-

**Table 8. Number of dresses owned by white and Negro rural and urban girls.**

| Group | Number Dresses<br>Less than 10 | 10 - 19 | 20 - 29 | 30 and Over | Total* Girls |
|---|---|---|---|---|---|
| | Percent | | | | No. |
| White rural | 14 | 49 | 30 | 7 | 232 |
| White urban | 16 | 51 | 25 | 8 | 424 |
| Negro rural | 40 | 46 | 11 | 3 | 153 |
| Negro urban | 19 | 55 | 19 | 7 | 194 |
| Average | 20 | 50 | 23 | 7 | 1003 |

*Two hundred and seventeen girls did not turn in an inventory or turned in an incomplete inventory.

**Table 9. Specified qualities which 267 teen-agers thought cotton, wool, and rayon dresses had.**

| Qualities | Most cotton dresses have these qualities | Most wool dresses have these qualities | Most rayon dresses have these qualities |
|---|---|---|---|
| | | Percent | |
| Hold their shape | 86 | 51 | 33 |
| Won't shrink | 66 | 29 | 31 |
| Won't fade | 34 | 63 | 31 |
| Real shiny | 14 | 7 | 46 |
| Gives warmth | 24 | 91 | 21 |
| Cool | 81 | 3 | 36 |
| Doesn't pick up dirt easily | 51 | 37 | 35 |
| Doesn't wrinkle easily | 21 | 72 | 28 |
| Will wear a long time; strong and durable | 67 | 72 | 27 |
| Easily washed | 91 | 4 | 29 |
| Require little or no ironing | 27 | 36 | 43 |
| Feels good to the skin | 79 | 28 | 40 |

tioned fiber or fabric as characteristic liked best.

About 51 percent of the dresses liked least by teen-agers were cotton. There was little difference in the four groups in this respect. Qualities disliked about the dress favored least were similar to qualities in the most popular dress. What the girls didn't like about the dress in order of importance were: (1) style, cut, or trimming; (2) fit; (3) color. Here, too, color was mentioned more by Negro than by white girls as a feature not liked.

Nine hundred and fifty-three girls reported on their newest dress.[10] About three-fourths of these dresses had been purchased within the past three months. Two-thirds were purchased ready-made with a median price of $10. About 50 percent were cotton dresses, and about seven-tenths of these had been bought in a store in the county where the girl attended school. Only 5 percent had been purchased by mail order. Six-tenths of the girls had personally picked out the last dress bought.

Two hundred and sixty-seven girls were asked to state whether or not they had worn a dress made of cotton, a dress made of wool, and a dress made of rayon. The following number said they had worn at one time or another:

| | No. who had worn |
|---|---|
| A cotton dress | 266* |
| A wool dress | 227 |
| A rayon dress | 146 |

*One girl did not report on whether or not she had worn a cotton dress.

The 267 girls were asked to check the qualities they thought most cotton, most wool, and most rayon dresses had. As will be noted (Table 9), one-half or more of the girls said: most cotton dresses will hold their shape; won't shrink; are cool; do not pick up dirt easily; will wear a long time; are easily washed; and feel good to the skin. These five qualities were named by 50 percent or more of the girls in connection with wool dresses: hold their shape; won't fade; give warmth; do not wrinkle easily; will wear a long time. No one quality for rayon dresses was named by 50 percent or more of the girls.

### Sweaters

The majority of girls in three of the four groups owned from 10 - 19 sweaters. In this other group, Negro rural, most of the girls owned 1 - 9 sweaters (see Table 10).

All 1003 girls giving information on number of sweaters owned had one or more sweaters in their wardrobes. In fact, there was only one girl who had only one sweater.

The following reported that they had shared sweaters with other girls, their mother, or both:

| | Percent sharing* |
|---|---|
| White rural | 21.4 |
| White urban | 23.6 |
| Negro rural | 18.5 |
| Negro urban | 14.1 |

*A report from 990 girls. See explanation in connection with sharing of blouses.

Nearly three-fourths of the girls sharing sweaters with another shared them with one other person. About one-fifth shared them with two other persons. The remainder shared them with 3 persons or more.

Fifty-eight percent of those sharing sweaters with others shared from 1 - 9 sweaters; 18 percent, 10 - 19 sweaters; and 3 percent, 20 or more sweaters. Twenty-one percent did not report the number shared. Twenty-six percent of those sharing sweaters shared all sweaters.

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[10] See footnote 7. The same procedure was used for dresses as for blouses.

About nine-tenths owned a sweater of man-made fiber (most often orlon) (Table 11 in Appendix), and about two-thirds owned an all-wool sweater (Table 10 in Appendix). About one-fourth owned a cotton sweater. Nearly one-fifth of the girls reported having sweaters of blends of two or more fibers. About the same proportion reported the fiber in one or more sweaters was "unknown" or gave no report on fiber. One-tenth gave fabric rather than fiber replies, such as bulky knit.

Fifty-seven percent of the sweaters named as the favorite sweater were orlon; 20 percent were wool. Only 4 percent named a cotton sweater as their favorite. Fifty percent of the sweaters liked least were orlon; 21 percent, wool; and 6 percent, cotton. Orlon and wool were the kinds of sweaters most often found in inventories.

About two-thirds of the girls in all groups had picked out their favorite sweater themselves; but only 40 percent had picked out the sweater in their wardrobe which they liked least. The things liked about this favorite sweater were in order of importance: (1) the color: (2) style or cut; (3) fiber or fabric. To be noted is the fact that fiber and fabric seem more important in sweaters than in the other three garments studied. The fiber and fabric was mentioned more by urban Negro girls than by those in the other groups. Here, too, color was mentioned by more Negro girls, especially Negro rural girls, than by girls in the other groups.

Things disliked about the sweater were in order of importance: (1) color; (2) fit; (3) style or cut. Here style and cut were mentioned by Negro girls more often than by white girls; also, more Negro than white girls mentioned color.

Nine hundred and forty-one girls reported on their newest sweater.[11] Nearly 4 percent of these sweaters were cotton, about 60 percent were of man-made fiber, and 18 percent were all wool. Seventy-seven percent of these sweaters had been purchased within the past 3 months. Ninety-eight percent were purchased ready-made at a median price of $8. About three-fourths of these sweaters had been bought in a store in the county where the girl attended school. Only 5 percent had been purchased by mail order. Six-tenths of the girls had picked out the last sweater bought themselves.

Two hundred and seventy-three girls were questioned about the experience they had had in wearing sweaters of cotton, wool, and orlon. The following number said they had worn at one time or another:

| | No. who had worn |
|---|---|
| An orlon sweater | 262 |
| A wool sweater | 242 |
| A cotton sweater | 140 |

These 273 girls were asked to check the qualities they thought most cotton, most wool, and most orlon sweaters had. As will be noted (Table 11), one-half or more of the girls said: most wool sweaters hold their shape; won't fade; give warmth; don't wrinkle easily; will wear a long time; require little or no ironing.

When asked about cotton sweaters, 50 percent or more of the girls named only two qualities (easily washed and feels good to the skin). Nine of the 12 qualities listed were named by this percentage in connection with orlon sweaters. These were: hold their shape: won't shrink; won't fade; give warmth; don't wrinkle easily; will wear a long time; are easily washed; require little or no ironing; feel good to the skin.

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[11] See footnote 7. The same procedure was followed for sweaters as for blouses.

**Table 10. Number of sweaters owned by white and Negro rural and urban girls.**

| Group | Number Sweaters 1 - 9 | 10 - 19 | 20 - 29 | 30 or more | Total* Girls |
|---|---|---|---|---|---|
| | Percent | | | | No. |
| White rural | 26 | 62 | 12 | ** | 232 |
| White urban | 20 | 65 | 13 | 2 | 424 |
| Negro rural | 59 | 38 | 3 | 0 | 153 |
| Negro urban | 41 | 50 | 8 | 1 | 194 |
| Average | 32 | 57 | 10 | 1 | 1003 |

*Two hundred and seventeen did not turn in an inventory or turned in an incomplete inventory.

**Less than .5 percent.

**Table 11. Specified qualities which 273 teen-agers thought cotton, wool, and orlon sweaters had.**

| Group | Most cotton sweaters have these qualities | Most wool sweaters have these qualities | Most orlon sweaters have these qualities |
|---|---|---|---|
| | | Percent | |
| Hold their shape | 37 | 59 | 74 |
| Won't shrink | 37 | 32 | 67 |
| Won't fade | 29 | 54 | 67 |
| Real Shiny | 13 | 5 | 29 |
| Gives warmth | 30 | 87 | 65 |
| Cool | 47 | 2 | 27 |
| Doesn't pick up dirt easily | 23 | 42 | 41 |
| Doesn't wrinkle easily | 20 | 57 | 58 |
| Will wear a long time; strong and durable | 33 | 74 | 62 |
| Easily washed | 61 | 24 | 77 |
| Require little or no ironing | 30 | 57 | 75 |
| Feels good to the skin | 53 | 24 | 83 |

## SUMMARY

The objectives of this study were to determine (a) kinds, amounts, and uses of selected outer garments owned by teen-age girls; (b) preferences for fibers in selected garments; and (c) marketing factors affecting type and kinds of garments owned.

Twelve hundred and twenty high school girls (principally in the eleventh grade) in 24 schools for white and Negro children in representative rural and urban areas in Bolivar, Choctaw, Hancock, Hinds, Jones and Lee Counties, Mississippi, were included.

The first and third schedules were filled out by girls at school under the supervision of a member of the Home Economics staff of the Mississippi Agricultural Experiment Station. The inventories (Schedule II) were filled out by the girls at home by wardrobe count.

One or more schedules were completed for 289 white girls in rural areas, 551 white girls in urban areas, 163 Negro girls in rural areas, and 217 Negro girls in urban areas. Median age of both rural and urban white girls was 16 years; of both rural and urban Negro girls, 17 years.

The majority of girls in all four groups had had Home Economics in school which included some work in clothing. About three-fourths of the rural girls had been members of a 4-H club at one time or another. Seventy-nine percent of these had worked on a clothing project. One-third of the urban girls were or had been members of a 4-H club and 84 percent of these had worked on a clothing project.

About 94 percent of the girls thought that they dressed about the same as their friends and 90 percent thought they dressed about the same as most girls in school. There was little difference in attitudes of girls in the four groups. Only about 10 percent of the girls reported they knew a lot about clothes and that friends often came to them for advice.

A set of eight samples was given each girl to determine her ability to judge fiber content. The majority (86 percent) identified less than one-half the samples correctly. There was little difference in abilities of girls in the four groups in judging the samples.

The majority of girls in all groups said they usually made decisions about whether to buy most of their clothes. All groups picked 15 - 16 years as the age a girl is old enough to do her own shopping.

Eighty-four percent of the girls said during the past year that they had purchased some clothes (or materials to make clothes) and paid for these with their own money or money given to them.

Fit, becomingness, and color were ranked by the girls as the most important features in the clothing they wore. Color was more important to Negro than to white girls. The fiber and weave ranked lowest in importance.

Both white and Negro girls liked skirts and sweaters best to wear to school in cold weather. In warm weather dresses or skirts and blouses were favored equally by white girls for school. Negro girls favored skirts and blouses over dresses for school in warm weather. Dresses were preferred in cold and warm weather by all groups for Sunday School or church and for dress-up parties.

Girls in all four groups preferred wool skirts, cotton blouses, and orlon sweaters for school in cold weather. Fiber preference for skirts, blouses, and dresses for school in warm weather was in all cases for cotton. Fibers most often named for specified garments for Sunday School or church and for dress-up parties were on the whole similar to fibers named in connection with these garments for school.

There was close agreement in what the girls said they liked best to wear to school and what they had on at the time of the first interview. Likewise, a close agreement in what they said they wore the last time they went to Sunday school or church or a dress-up party and what they said they preferred.

There were more similarities than differences in inventories of blouses, skirts, dresses, and sweaters of girls in the four groups. Most owned from 10 - 19 each of these four garments. But rural Negro girls had smaller inventories of the specified garments; urban white girls, larger. Rural white girls usually had more of the garments than urban Negro girls.

One-fourth shared one or more blouses, one-fifth one or more skirts and sweaters, and one-eighth one or more dresses with sisters or mothers. The pattern was to share certain of these garments but not all. Cotton played a leading role in blouses, dresses, and skirts owned by girls in all four groups. However, wool was about as important as cotton for skirts. Cotton was of minor importance in sweaters.

The favorite garments in inventories for the majority were: a cotton blouse, a wool skirt, a cotton dress, and an orlon sweater. The three characteristics liked most about these favorite garments were the style, color, and fit. But in the case of sweaters, more mentioned fiber and fabric than fit.

The garments liked least in inventories of the majority of girls were: a cotton blouse, a cotton skirt, a cotton dress, and an orlon sweater. The characteristic disliked most about these unpopular garments were the same as qualities liked about the favorite garments. More girls had picked out their favorite blouse, skirt, dress, and sweater than had picked out the garments they favored least. Color was more important to the Negro than to the white girls, and to the rural Negro girls than to the urban Negro girls.

The newest of these four garments were generally ready-made, purchased at a store in the county in which the girl resided, and selected by the girl herself. The median amount paid for the garments ranged from $4 for the blouse to $10 for the dress. The majority of newest dresses and blouses were cotton; of newest skirts, wool; of newest sweaters, a man-made fiber.

When asked about the qualities most cotton, wool, rayon, nylon, and orlon garments had, the girls most often checked the following qualities for cotton: won't shrink; cool; easily washed; feels good to the skin. Wool and cotton received about the same rating on the following qualities: holds shape; will wear a long time; strong and durable. Wool garments rated higher than cotton on the following qualities: won't fade; gives warmth; doesn't wrinkle easily. None of the four cotton garments were rated by 50 percent or more girls as having qualities of: won't fade; doesn't wrinkle easily; requires little or no ironing.

## IMPLICATIONS

There are some implications in this study for producers, manufacturers, and retailers as well as for home economists.

Some of the implications for producers, manufacturers, and retailers are:

(1) Teen-agers make decisions as to when and where to buy many outer garments, using their own money or money given to them by parents. They need constructive help in finding the qualities they want. Advertising should be di-

rected towards them and their needs.

(2) The fiber or fabric in a garment is relatively unimportant to the teen-ager. Color, becomingness, and fit are qualities they look for in clothes they wear. This is a fact deserving serious consideration by manufacturers and retailers.

(3) The majority of teen-agers think of themselves as in a large group of other teen-agers, dressing the same as these other girls. This fact signifies the need for many garments in the market similar in style and appearance but different in price range.

(4) Different types of garments are wanted for different occasions. This is another fact deserving consideration by manufacturers and retailers.

(5) Since identification of fibers is difficult, especially man-made fibers and blends of the same, it is important that labels be sewed to ready-made clothing so they can not be destroyed. Name of fibers in piece goods might well be woven into the selvage.

(6) Cotton garments were rated low by teen-agers in qualities such as "doesn't wrinkle easily", "requires little or no ironing". Teen-agers need to be aware of recent research in wash and wear cottons and where and when such materials will be available.

(7) Cotton garments were rated high by teen-agers in qualities such as holds shape; won't shrink; cool; will wear a long time, durable; easily washed; feels good to my skin. These are qualities that might well be used in advertising cotton garments to teen-agers.

Some of the implications of this study for home economists are:

(1) Teen-agers do not think of themselves as different from their friends or other girls in school in regard to clothing. There must be a certain conformity in dress.

(2) The teen-ager considers she knows "a little about clothing". This probably means that she will be receptive to help if given in the right manner.

(3) Fiber identification does not seem possible for the majority due to wide range of textile fibers in the market. Therefore, emphasis should be placed by teachers on careful examination of all labels.

(4) Teen-agers make decisions about what clothes to buy and have experience in the buying process. They are better satisfied with the clothing they themselves pick out. Educational programs directed to this group of teen-age consumers should place greater emphasis on the selection of ready-made garments including color suitable for the particular girl and the fit of the garment.

(5) More information is needed on the number of garments that constitute a reasonable and acceptable wardrobe. With rapid growth of teen-aged girls and frequent change in style in would seem advisable to have smaller inventories with greater use per unit. The practice of owning certain garments with other members needs further study. It would seem an economical practice.

(6) It is important that research in wash and wear cotton garments be made available to teen-agers as soon as reported, and that merchants in the local community be asked to include these newer products in their stock.

(7) Qualities of the most com-

mon natural and man-made fibers including care of these and purposes for which each is best suited should be basic information in clothing courses given to teenagers.

## APPENDICES

### I. Schools included in the Study

The schools included in this study were as follows: Central High School and Lanier Junior-Senior High School, both in Jackson; Clinton High School and Sumner Hill High School, Clinton; George S. Gardiner High School and Oak Park High School, Laurel; Glade High School, RFD, Laurel; Benson High School, RFD, Ellisville; Ackerman High School and Choctaw County Training School, Ackerman; Tupelo High School and Carver High School, Tupelo; Nettleton High School and Nettleton Line Colored High School, Nettleton; Bay High School, Valema C. Jones High School, St. Joseph's Academy, and St. Rose De Lima School, all of Bay St. Louis; North Central High School, RFD, Pass Christian; Cleveland High School and East Side High School, Cleveland; Shaw High School, Shaw; Mound Bayou High School, Mound Bayou; and Clarksdale High School, Clarksdale.

### II. Mail Order Catalog Descriptions of Sample Fabrics Used in Study*

Sample No. 1

Domestic organdy. Permanently crisp, combed cotton. Washable; 38 inches wide. Catalog No. 36 Y 3135. Yard - 44c.

Sample No. 2

Dressweight Velvet. Transparent type. Lustrous rayon. Dry clean. Catalog No. 36 Y 9185. Yard - $2.32.

Sample No. 3

Good quality easy care cotton. A wonderful buy at this low price. New prints and solids in washfast colors. Easy-to-care-for cottons need little or no ironing. Pre-shrunk, maximum shrinkage 2%. Catalog No. 36 Y 3348. Yard - 44c.

Sample No. 4

Dacron and Cotton. Permanent wash and wear blend of 65% dacron, 35% cotton. No-iron feature can't wash out. Crease-resistant, keeps pleats, won't cling. Drip-dry. For separates, dresses, sportswear. 36 inches. Catalog No. 36 Y 8580. Yard - 93c.

Sample No. 5

Nylon organdy. For bouffant dresses and petticoats. Permanently crisp. Hand washable, 44 inches wide. Catalog No. 36 Y 8294. Yard - 71c.

Sample No. 6

Velveteen. Washable lustrous combed cotton. Crush resistant. Twill-back weave fastens pile, never sheds. 36 inches. Catalog No. 36 Y 9175. Yard - $2.76.

Sample No. 7

Perma-smooth corduroy is wash and wear, needs little or no ironing, dries quickly, resists wrinkles. Soft combed cotton for longer wear, richer colors. Water-repellent; resists water-borne spots, soil. Machine washable; maximum shrinkage 2%. For children's wear, separates. 17 wales per inch. Catalog No. 36 Y 9160. 36 inches. Yard - $1.57. Sample No. 8

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*Materials were purchased from Sears, Roebuck and Company, Memphis, Tennessee. They were selected from their 1959 Fall Catalog.

Wash and wear orlon and wool blend. 65% orlon, 35% wool. Machine washable, drip dry (do not spin or tumble); shake or brush gently and wear. Crease-resistant. Maximum shrinkage 2%. 54 inches wide. Catalog No. 36 Y 7765. Yard - $2.86.

## III. Tables

**Table 1. Persons whom the girls say usually make decisions about clothes they buy.**

| Group | I do | Mother does | Mother and I | Somebody else | No report | Total No. girls |
|---|---|---|---|---|---|---|
| | | | Percent | | | |
| White rural | 72.7 | 17.6 | 8.3 | 1.4 | 0 | 289 |
| White urban | 74.6 | 21.8 | 2.0 | .9 | .7 | 551 |
| Negro rural | 68.1 | 30.1 | 0 | 1.2 | .6 | 163 |
| Negro urban | 57.2 | 37.3 | .5 | 4.1 | .9 | 217 |
| Average | 70.1 | 24.7 | 3.0 | 1.6 | .6 | 1220 |

**Table 2. Age girls think a girl is old enough to do her shopping and pick out her own clothes.**

| Group | Under 13 yrs. | 13-14 yrs. | 15-16 yrs. | 17-18 yrs. | 19 yrs. & over | Qualified* | No report | Total No. girls |
|---|---|---|---|---|---|---|---|---|
| | | | | Percent | | | | |
| White rural | 6.5 | 30.8 | 47.4 | 9.0 | .7 | 4.2 | 1.4 | 289 |
| White urban | 6.9 | 37.6 | 40.6 | 5.6 | .9 | 5.1 | 3.3 | 551 |
| Negro rural | 11.0 | 31.9 | 46.8 | 6.7 | .6 | .6 | 2.4 | 163 |
| Negro urban | 13.4 | 29.5 | 43.5 | 6.7 | 1.8 | 2.3 | 2.8 | 217 |
| Average | 8.5 | 33.8 | 43.6 | 6.7 | 1.0 | 3.8 | 2.6 | 1220 |

*Such as "depends on girl", "age isn't important", "when she's old enough to make decisions", "when earning own money".

**Table 3. Things checked as important in clothes they wear by white and Negro rural and urban girls.***

| Group | Color | Fit | In fashion | Weave | Fiber | Becomingness | Total No. girls |
|---|---|---|---|---|---|---|---|
| | | | Percent | | | | |
| White rural | 88.6 | 99.3 | 68.9 | 22.8 | 51.2 | 90.7 | 289 |
| White urban | 87.8 | 98.9 | 73.1 | 21.2 | 48.1 | 95.6 | 551 |
| Negro rural | 95.7 | 97.5 | 65.6 | 36.8 | 63.2 | 73.6 | 163 |
| Negro urban | 91.7 | 96.8 | 58.5 | 35.5 | 53.9 | 85.3 | 217 |
| Average | 89.8 | 98.4 | 68.5 | 26.2 | 51.9 | 89.7 | 1220 |

*From six items given girls were asked to check those they considered important in the clothes they wear.

**Table 4. Kind of clothing 1220 girls like best in cold and warm weather to wear to school, Sunday School or Church, and to dress-up parties.***

| Occasion, weather garment | 289 White girls* Rural | 551 White girls* Urban | 163 Negro girls* Rural | 217 Negro girls* Urban |
|---|---|---|---|---|
| | | Percent | | |
| SCHOOL | | | | |
| Cold Weather | | | | |
| Skirts and blouses | 5.2 | 6.5 | 6.1 | 8.7 |
| Skirts and sweaters | 93.8 | 91.5 | 90.2 | 90.3 |
| Dresses | .3 | 1.3 | 2.4 | 0 |
| Warm Weather | | | | |
| Skirts and blouses | 49.8 | 41.6 | 73.6 | 76.0 |
| Skirts and sweaters | 1.7 | .4 | 6.7 | 2.8 |
| Dresses | 46.7 | 56.8 | 19.0 | 18.0 |
| SUNDAY SCHOOL, CHURCH | | | | |
| Cold Weather | | | | |
| Skirts and blouses | 9.0 | 10.5 | 3.7 | 5.5 |
| Skirts and sweaters | 30.4 | 22.3 | 41.1 | 28.1 |
| Dresses | 57.1 | 63.3 | 54.0 | 65.0 |
| Warm Weather | | | | |
| Skirts and blouses | 8.0 | 5.6 | 30.1 | 23.5 |
| Skirts and sweaters | 1.7 | .5 | 4.3 | 2.8 |
| Dresses | 88.9 | 92.4 | 63.8 | 70.5 |
| DRESS-UP PARTIES | | | | |
| Cold Weather | | | | |
| Skirts and blouses | 3.5 | 2.5 | 6.1 | 7.4 |
| Skirts and sweaters | 23.2 | 9.2 | 25.8 | 18.9 |
| Dresses | 64.0 | 82.4 | 57.1 | 64.5 |
| Warm Weather | | | | |
| Skirts and blouses | 8.0 | 3.4 | 20.2 | 17.0 |
| Skirts and sweaters | .3 | .7 | 3.1 | 5.1 |
| Dresses | 82.4 | 89.7 | 64.4 | 68.2 |

*Does not add up to 100% since does not include those not going to Sunday School or Church and to dress-up parties; also a few who checked more than one type of clothing per season and occasion, or gave no report.

**Table 5. Fiber preferences for dresses for school, for Sunday School or Church, and for dress-up parties in cold and warm weather, 1220 white and Negro rural and urban girls.**

| Occasion, weather garment | Cotton | Wool | Fabric & other fiber replies* | No preference | Don't go Don't wear or no report | Total No. Girls |
|---|---|---|---|---|---|---|
| | | | Percent | | | |
| DRESSES - SCHOOL | | | | | | |
| Cold Weather | | | | | | |
| White rural | 34.9 | 22.5 | 6.9 | 19.0 | 16.7 | 289 |
| White urban | 41.4 | 22.9 | 4.3 | 19.2 | 12.2 | 551 |
| Negro rural | 24.5 | 52.8 | 6.7 | 7.4 | 8.6 | 163 |
| Negro urban | 22.1 | 43.3 | 10.6 | 12.9 | 11.1 | 217 |
| Warm Weather | | | | | | |
| White rural | 82.7 | 0 | 4.8 | 8.3 | 4.2 | 289 |
| White urban | 88.4 | 0 | 2.9 | 3.4 | 5.3 | 551 |
| Negro rural | 81.7 | 0 | 14.7 | 1.8 | 1.8 | 163 |
| Negro urban | 82.0 | 0 | 9.7 | 6.0 | 2.3 | 217 |
| DRESSES - SUNDAY SCHOOL AND CHURCH | | | | | | |
| Cold Weather | | | | | | |
| White rural | 13.1 | 49.1 | 16.3 | 15.9 | 5.6 | 289 |
| White urban | 9.2 | 45.6 | 15.8 | 25.2 | 4.2 | 551 |
| Negro rural | 12.9 | 69.3 | 11.7 | 5.5 | .6 | 163 |
| Negro urban | 6.4 | 62.2 | 17.1 | 13.4 | .9 | 217 |
| Warm Weather | | | | | | |
| White rural | 54.3 | 0 | 24.2 | 17.0 | 4.5 | 289 |
| White urban | 63.5 | 0 | 15.9 | 16.2 | 4.4 | 551 |
| Negro rural | 60.1 | 0 | 31.8 | 6.1 | 2.0 | 163 |
| Negro urban | 53.4 | 0 | 32.8 | 11.1 | 2.7 | 217 |
| DRESSES - PARTIES | | | | | | |
| Cold Weather | | | | | | |
| White rural | 11.1 | 8.6 | 39.8 | 22.1 | 18.4 | 289 |
| White urban | 5.8 | 13.8 | 41.5 | 27.4 | 11.5 | 551 |
| Negro rural | 9.2 | 22.7 | 31.2 | 9.2 | 27.7 | 163 |
| Negro urban | 9.7 | 19.4 | 37.3 | 16.1 | 17.5 | 217 |
| Warm Weather | | | | | | |
| White rural | 30.8 | 0 | 30.5 | 19.7 | 19.0 | 289 |
| White urban | 33.0 | 0 | 30.2 | 22.5 | 14.3 | 551 |
| Negro rural | 27.0 | 0 | 39.8 | 7.4 | 25.8 | 163 |
| Negro urban | 31.8 | 0 | 35.5 | 14.3 | 19.4 | 217 |

*Included in this group were items such as chiffon, velveteen, velvet, organdy, taffeta, jersey, linen, silk, nylon, rayon.

**Table 6. Fiber preference for blouses for school, for Sunday School or Church and for dress-up parties in cold and warm weather, 1220 white and Negro rural and urban girls.**

| Occasion, weather, garment | Cotton | Man-made fibers | Fabric & other fiber replies* | No preference | Don't go Don't wear no report | Total No. Girls |
|---|---|---|---|---|---|---|
| | | | Percent | | | |
| BLOUSES - SCHOOL | | | | | | |
| Cold Weather | | | | | | |
| White rural | 86.3 | 3.1 | 1.3 | 5.5 | 3.8 | 289 |
| White urban | 83.5 | 1.6 | 2.0 | 8.0 | 4.9 | 551 |
| Negro rural | 79.1 | 7.4 | 4.9 | 3.7 | 4.9 | 163 |
| Negro urban | 81.1 | 4.1 | 5.1 | 7.4 | 2.3 | 217 |
| Warm Weather | | | | | | |
| White rural | 85.9 | 4.8 | 2.8 | 5.5 | 1.0 | 289 |
| White urban | 88.7 | 3.9 | 1.8 | 3.6 | 2.0 | 551 |
| Negro rural | 77.4 | 5.5 | 12.9 | 2.4 | 1.8 | 163 |
| Negro urban | 83.5 | 6.4 | 4.6 | 4.1 | 1.4 | 217 |
| BLOUSES - SUNDAY SCHOOL AND CHURCH | | | | | | |
| Cold Weather | | | | | | |
| White rural | 51.2 | 14.5 | 5.9 | 11.1 | 17.3 | 289 |
| White urban | 46.5 | 15.9 | 4.7 | 14.7 | 18.2 | 551 |
| Negro rural | 63.8 | 13.6 | 9.2 | 6.7 | 6.7 | 163 |
| Negro urban | 49.0 | 14.6 | 12.9 | 10.1 | 13.4 | 217 |
| Warm Weather | | | | | | |
| White rural | 56.9 | 13.4 | 3.1 | 9.3 | 17.3 | 289 |
| White urban | 61.2 | 8.4 | 2.2 | 12.2 | 16.0 | 551 |
| Negro rural | 58.9 | 23.5 | 6.1 | 6.7 | 4.8 | 163 |
| Negro urban | 59.0 | 18.4 | 3.2 | 7.4 | 12.0 | 217 |
| BLOUSES - PARTIES | | | | | | |
| Cold Weather | | | | | | |
| White rural | 23.2 | 15.0 | 10.4 | 10.4 | 41.0 | 289 |
| White urban | 21.1 | 16.2 | 8.3 | 16.3 | 38.1 | 551 |
| Negro rural | 30.1 | 17.1 | 12.3 | .6 | 39.9 | 163 |
| Negro urban | 22.6 | 16.5 | 13.4 | 10.1 | 27.4 | 217 |
| Warm Weather | | | | | | |
| White rural | 31.1 | 10.7 | 5.5 | 12.8 | 39.9 | 289 |
| White urban | 34.1 | 9.1 | 4.0 | 16.9 | 35.9 | 551 |
| Negro rural | 35.8 | 18.2 | 4.9 | 4.9 | 36.2 | 163 |
| Negro urban | 38.7 | 13.8 | 6.9 | 7.4 | 33.2 | 217 |

*Such as silk, velveteen, velvet, taffeta.

**Table 7. Fiber preference for skirts for school, for Sunday School or Church, and for dress-up parties in cold and warm weather, 1220 white and Negro rural and urban girls.**

| Occasion, weather, garment | Cotton | Wool | Fabric & other fiber replies* | No preference | Don't go, Don't wear or no report | Total No. Girls |
|---|---|---|---|---|---|---|
| | | | Percent | | | |
| SKIRTS - SCHOOL | | | | | | |
| Cold Weather | | | | | | |
| White rural | 1.4 | 86.2 | 5.2 | 5.9 | 1.3 | 289 |
| White urban | 2.3 | 85.5 | 3.5 | 7.2 | 1.5 | 551 |
| Negro rural | 3.7 | 82.8 | 9.2 | 3.7 | .6 | 163 |
| Negro urban | .9 | 85.3 | 7.8 | 5.5 | .5 | 217 |
| Warm Weather | | | | | | |
| White rural | 86.2 | 0 | 2.8 | 9.0 | 2.0 | 289 |
| White urban | 82.2 | 0 | 6.2 | 8.9 | 2.7 | 551 |
| Negro rural | 84.8 | 0 | 11.0 | 1.8 | 2.4 | 163 |
| Negro urban | 84.8 | 0 | 9.8 | 4.1 | 1.3 | 217 |
| SKIRTS - SUNDAY SCHOOL AND CHURCH | | | | | | |
| Cold Weather | | | | | | |
| White rural | 1.7 | 81.4 | 4.8 | 6.2 | 5.9 | 289 |
| White urban | 2.4 | 73.5 | 4.0 | 10.3 | 9.8 | 551 |
| Negro rural | 3.7 | 81.0 | 7.4 | 3.7 | 4.2 | 163 |
| Negro urban | .9 | 73.4 | 12.0 | 6.4 | 7.3 | 217 |
| Warm Weather | | | | | | |
| White rural | 55.1 | 0 | 12.8 | 13.1 | 19.0 | 289 |
| White urban | 57.2 | 0 | 10.2 | 12.8 | 19.8 | 551 |
| Negro rural | 70.7 | 0 | 15.3 | 6.7 | 7.3 | 163 |
| Negro urban | 61.8 | 0 | 15.1 | 9.2 | 13.9 | 217 |
| SKIRTS - PARTIES | | | | | | |
| Cold Weather | | | | | | |
| White rural | 1.0 | 34.6 | 15.9 | 10.0 | 38.5 | 289 |
| White urban | 3.4 | 30.7 | 16.7 | 15.4 | 33.7 | 551 |
| Negro rural | 3.7 | 38.6 | 16.5 | 3.7 | 37.5 | 163 |
| Negro urban | 5.1 | 34.6 | 17.0 | 7.4 | 35.9 | 217 |
| Warm Weather | | | | | | |
| White rural | 28.0 | 0 | 12.7 | 17.0 | 42.3 | 289 |
| White urban | 32.8 | 0 | 11.7 | 18.0 | 37.5 | 551 |
| Negro rural | 41.1 | 0 | 17.7 | 4.3 | 36.9 | 163 |
| Negro urban | 39.2 | 0 | 16.1 | 9.2 | 35.5 | 217 |

*Such as velveteen, taffeta, velvet, tweed, corduroy, denim, gabardine, rayon, linen, nylon, silk.

**Table 8. Fiber preference for sweaters for school, for Sunday School or Church and for dress-up parties, cold weather*, 1220 white and Negro rural and urban girls.**

| Occasion - Garment | Wool or cash-mere | Orlon | Other man-made fibers and blends** | No pre-ference | Don't go, Don't wear or no report | Total No. Girls |
|---|---|---|---|---|---|---|
| | | | Percent | | | |
| SWEATERS - SCHOOL | | | | | | |
| White rural | 11.1 | 32.9 | 41.9 | 13.1 | 1.0 | 289 |
| White urban | 17.6 | 31.9 | 29.6 | 17.2 | 3.7 | 551 |
| Negro rural | 23.9 | 31.4 | 36.2 | 6.7 | 1.8 | 163 |
| Negro urban | 24.4 | 41.4 | 24.0 | 8.8 | 1.4 | 217 |
| SWEATERS - SUNDAY SCHOOL AND CHURCH | | | | | | |
| White rural | 11.8 | 27.7 | 39.7 | 11.8 | 9.0 | 289 |
| White urban | 15.6 | 22.3 | 32.0 | 16.2 | 13.9 | 551 |
| Negro rural | 19.6 | 31.9 | 36.9 | 4.9 | 6.7 | 163 |
| Negro urban | 19.8 | 39.7 | 25.3 | 6.9 | 8.3 | 217 |
| SWEATERS - PARTIES | | | | | | |
| White rural | 4.5 | 17.3 | 29.5 | 9.3 | 39.4 | 289 |
| White urban | 6.0 | 12.9 | 28.4 | 13.4 | 39.3 | 551 |
| Negro rural | 7.4 | 24.5 | 28.2 | 2.4 | 38.5 | 163 |
| Negro urban | 11.1 | 28.6 | 19.4 | 6.9 | 34.0 | 217 |

*No cotton sweaters mentioned in fiber preference.

**Such as banlon, nylon, rayon, acrilan, dacron.

**Table 9. Number of cotton blouses, skirts, and dresses in inventories of 1003 white and Negro rural and urban girls.***

| Garment and Group | None | 1 - 9 | 10 - 19 | 20 or more | Total No. girls** |
|---|---|---|---|---|---|
| | | Percent | | | |
| COTTON BLOUSES | | | | | |
| White rural | 0 | 26.3 | 53.9 | 19.9 | 232 |
| White urban | .5 | 15.1 | 53.5 | 30.9 | 424 |
| Negro rural | 1.3 | 63.4 | 29.4 | 5.9 | 153 |
| Negro urban | .5 | 45.9 | 39.7 | 13.9 | 194 |
| Average | .5 | 31.0 | 47.3 | 21.2 | 1003 |
| COTTON SKIRTS | | | | | |
| White rural | 1.7 | 72.8 | 23.7 | 1.7 | 232 |
| White urban | 4.5 | 68.9 | 24.8 | 1.8 | 424 |
| Negro rural | 5.9 | 75.8 | 17.6 | .6 | 153 |
| Negro urban | 2.6 | 67.5 | 28.4 | 1.5 | 194 |
| Average | 3.7 | 70.6 | 24.1 | 1.6 | 1003 |
| COTTON DRESSES | | | | | |
| White rural | 1.7 | 44.8 | 44.0 | 9.5 | 232 |
| White urban | 1.2 | 48.3 | 42.0 | 8.5 | 424 |
| Negro rural | 3.3 | 83.7 | 12.4 | .6 | 153 |
| Negro urban | 2.1 | 71.6 | 23.2 | 3.1 | 194 |
| Average | 1.8 | 57.4 | 34.3 | 6.5 | 1003 |

* Twenty-three percent of white rural, 13 percent of white urban, 44 percent of Negro rural and 28 percent of the Negro urban girls reported 1 - 4 cotton sweaters in inventory. Three percent in each white group and 5 percent in each Negro group reported 5 or more cotton sweaters.

**Two hundred and seventeen did not return inventory or turned in an incomplete inventory.

**Table 10. Number of wool skirts, sweaters, dresses, and blouses in inventories of 1003 white and Negro rural and urban girls.**

| (a) Garment and Group | None | 1 - 9 | 10 - 19 | 20 or more | Total No. girls* |
|---|---|---|---|---|---|
| | Percent | | | | |
| WOOL SKIRTS | | | | | |
| White rural | .9 | 74.1 | 24.6 | .4 | 232 |
| White urban | 2.4 | 73.3 | 23.1 | 1.2 | 424 |
| Negro rural | 4.6 | 81.7 | 12.4 | 1.3 | 153 |
| Negro urban | 2.6 | 76.8 | 19.1 | 1.5 | 194 |
| Average | 2.4 | 75.5 | 21.0 | 1.1 | 1003 |
| WOOL SWEATERS | | | | | |
| White rural | 42.2 | 54.8 | 3.0 | 0 | 232 |
| White urban | 35.8 | 58.3 | 5.4 | .5 | 424 |
| Negro rural | 32.7 | 64.1 | 3.2 | 0 | 153 |
| Negro urban | 21.1 | 72.7 | 5.7 | .5 | 194 |
| Average | 34.0 | 61.1 | 4.6 | .3 | 1003 |

| (b) Garment and Group | None | 1 - 4 | 5 or more | Total No. girls* |
|---|---|---|---|---|
| | Percent | | | |
| WOOL DRESSES | | | | |
| White rural | 40.5 | 56.5 | 3.0 | 232 |
| White urban | 41.5 | 54.0 | 4.5 | 424 |
| Negro rural | 35.3 | 54.9 | 9.8 | 153 |
| Negro urban | 32.0 | 59.8 | 8.2 | 194 |
| Average | 38.5 | 55.8 | 5.7 | 1003 |
| WOOL BLOUSES | | | | |
| White rural | 88.4 | 11.6 | 0 | 232 |
| White urban | 83.7 | 15.8 | .5 | 424 |
| Negro rural | 81.8 | 17.6 | .6 | 153 |
| Negro urban | 79.9 | 18.0 | 2.1 | 194 |
| Average | 83.7 | 15.6 | .7 | 1003 |

*Two hundred and seventeen did not return inventory or turned in incomplete inventory.

**Table 11. Number of man-made fiber sweaters, blouses, dresses and skirts in inventories of 1003 white and Negro rural and urban girls.**

| (a) Garment and Group | None | 1 - 9 | 10 - 19 | 20 or more | Total No. girls* |
|---|---|---|---|---|---|
| | | Percent | | | |
| MAN-MADE FIBER SWEATERS | | | | | |
| White rural | 3.4 | 49.6 | 43.6 | 3.4 | 232 |
| White urban | 5.7 | 43.6 | 46.0 | 4.7 | 424 |
| Negro rural | 22.9 | 68.6 | 8.5 | 0 | 153 |
| Negro urban | 13.4 | 70.1 | 14.4 | 2.1 | 194 |
| Average | 9.3 | 53.9 | 33.6 | 3.2 | 1003 |

| (b) Garment and Group | None | Less than 5 | 5 - 9 | 10 and over | Total No girls* |
|---|---|---|---|---|---|
| | | Percent | | | |
| MAN-MADE FIBER BLOUSES | | | | | |
| White rural | 46.6 | 46.1 | 6.0 | 1.3 | 232 |
| White urban | 51.6 | 42.9 | 5.0 | .5 | 424 |
| Negro rural | 38.6 | 57.5 | 3.3 | .6 | 153 |
| Negro urban | 52.1 | 40.7 | 6.7 | .5 | 194 |
| Average | 48.5 | 45.5 | 5.3 | .7 | 1003 |

| (c) Garment and Group | None | 1 - 4 | 5 or more | Total No. girls* |
|---|---|---|---|---|
| | | Percent | | |
| MAN-MADE FIBER DRESSES | | | | |
| White rural | 34.5 | 53.4 | 12.1 | 232 |
| White urban | 40.6 | 49.8 | 9.6 | 424 |
| Negro rural | 38.6 | 51.0 | 10.4 | 153 |
| Negro urban | 33.0 | 55.2 | 11.8 | 194 |
| Average | 37.4 | 51.8 | 10.8 | 1003 |
| MAN-MADE FIBER SKIRTS | | | | |
| White rural | 61.2 | 37.1 | 1.7 | 232 |
| White urban | 64.7 | 31.1 | 4.2 | 424 |
| Negro rural | 68.0 | 30.7 | 1.3 | 153 |
| Negro urban | 66.5 | 29.9 | 3.6 | 194 |
| Average | 64.7 | 32.2 | 3.1 | 1003 |

*Two hundred and seventeen did not return inventory or turned in an incomplete inventory.

BULLETIN 637 FEBRUARY 1962

# Mississippi Cotton Variety Tests, 1961

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MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

## THE AUTHORS

DELTA TESTS—James B. Dick and Norman E. Justus

HILL SECTION TESTS — G. D. Green, R. E. Coats, S. P. Crockett, B. C. Hurt, B.E. B. E. Waggoner and L. B. Walton

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### Sources of Seed

Acala 4-42: Bred in California. Our seed from Delta Branch Station, Stoneville, Miss.

All-In-One: W. W. Wannamaker Seed Farms, Inc., St. Matthews, S. C.

Auburn 56 and Plains: Ala. Agri. Exp. Station, Auburn, Ala.

Coker; all strains and Delta Queen: Coker's Pedigree Seed Co., Hartsville, S. C.

DeKalb 108 and 220: Dekalb Agri. Assn., Inc., Bogart, Ga.

Delfos and Stoneville; all strains: Stoneville Pedigreed Seed Co., Stoneville, Miss.

Deltapine; all strains and Fox 4: Delta and Pine Land Co., Scott, Mississippi.

Dixie King; all strains: Bobshaw Pedigreed Seed Co., Indianola, Miss.

Empire; all strains: Empire Pedigreed Seed Co., Haralson, Ga.

Lankart 57: Bred in Texas. Our seed from Delta Branch Exp. Station, Stoneville, Miss.

Rex: Cotton Branch Experiment Station, Mariana, Ark.

K-7: Tennessee Agricultural Experiment Station.

# Mississippi Cotton Variety Tests For 1961

## IN THE DELTA

Cotton variety trials were conducted by the Delta Branch Experiment Station in 1961 at the following four locations in the alluvial Yazoo-Mississippi Delta: The Delta Station at Stoneville, the Woolfolk Plantation near Tunica, the Heaton Plantation at Clarksdale, and the Schaeffer Plantation near Yazoo City.

The 1961 season varied somewhat over the Delta, as would be expected, but was unusual over the entire area in these respects. Most cotton was planted later than usual because of cool weather and wet soil in late April and early May. Cool weather, rains, and many days of low light intensity during June and July were conducive to plant growth, and fruiting was generally very slow. In most sections, except where early plantings were successfully made, most of the bolls were set during late July and the first 20 days of August. Fruiting during this period was very heavy and final yields were much higher than conditions in mid-July indicated would be possible. Cotton harvesting ordinarily begins in late August and early September. However, the conditions described above delayed maturity, and harvesting began 2 to 3 weeks later than usual in most of the Delta.

The latter part of September and the month of October brought excellent weather which was used to advantage in rapid harvesting by all available means. Yields on many plantations averaged 700 to 900 pounds of lint per acre. A killing frost and temperature of 30°F. on October 27 stopped all plant and boll development and left many unopened bolls in late-planted cotton.

Delta cotton from the last few crops has been of inferior quality because of deterioration from boll rot and weather damage. Laboratory tests on hundreds of bales of cotton indicate that the 1961 crop is one of the best quality crops ever produced in the Mississippi Delta. Grade, fiber length, micronaire, and fiber strength have been exceptionally good.

Current strains of 15 commercial varieties were used in the 1961 variety trials. At Stoneville and Tunica, California Acala 4-42 and Texas Lankart 57 were added. Delta Queen is a new variety being released by Coker's Pedigreed Seed Company. DeKalb varieties were included in the 1961 tests for the first time.

### Stoneville

Table 1 gives the results of the yield trial at the Delta Station. The test was planted on May 10, ten days to three weeks later than usual. Emergence was very good but the test was damaged by seedling disease to some extent. Insect control was excellent. Seasonal conditions have been described above. Fruiting was delayed and very few bolls were set prior to July 20, after which fruiting was very heavy. The first picking was made on October 12, at which time 54 percent of the entire yield was harvested. Yields ranged from 764 to 1150 pounds of lint per acre, with an overall average yield of 1026 pounds. The average yield on the same area in 1960 was 666 pounds. Lint percentages were lower and staple lengths longer than normal. Tensile strength was very good, and the micronaire index showed the fiber to be about average for the several varieties.

### Tunica

Table 2 gives results of the yield trial conducted on the Woolfolk Plantation 6 miles northeast of Tunica. The planting on May 12 resulted in very good stands. Cool weather and low light intensity dur-

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[1] Research Agronomists, Cotton & Cordage Fibers Research Branch, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture. This report is based upon results from cooperative research conducted by the Mississippi Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.

ing the early part of the growing season delayed fruiting. Sufficient moisture and good conditions in July, August, and September were conducive to fruiting and resulted in an excellent crop being set in late July and August. A first picking was made on October 6, at which time 41 percent of the cotton was harvested.

The earliness of Rex, Empire, and Stoneville 3202 was apparent in the amount of cotton harvested from these varieties on October 6. Percentagewise the other varieties were medium in maturing and opening. Total lint yields ranged from 1145 pounds of lint per acre for Stoneville 3202 to 700 pounds for Lankart 57, with an overall average of 969 pounds. The average yield in 1960 was 1207 pounds. Lint percentages were somewhat low. Staple lengths were good. Fiber strength was about normal. The micronaire index indicated that the fiber was finer than normal, but still in the range desired by most mills.

### Clarksdale

Table 3 gives the results from the outlying test at Clarksdale. The test plots were planted on April 28. Good stands were obtained and very little damping off occurred. Abnormally cool weather delayed fruiting, but favorable weather from July 20 through October allowed heavy fruiting. The final lint yields averaged 843 pounds per acre for the 15 varieties. The first picking on October 10 resulted in harvesting 48 percent of the total yield. Final picking on November 10 left very few unopened bolls on any of the plots. Heaviest yields at first picking again came from the early varieties. Lint percentages at Clarksdale were lower than normal. Staple length and fiber strength were about normal. The micronaire index indicated slightly finer fibers than the varieties ordinarily produce.

### Yazoo City

Data from the test conducted near Yazoo City are given in Table 4. The test was planted on April 26 with good resulting stands. Early cool weather with light rains delayed fruiting. Excessive rainfall between July 1 and July 25 limited cultivation. No rainfall occurred after July 25 and favorable conditions allowed heavy fruiting. Final yields of the varieties ranged from 900 to 1200 pounds of lint per acre, with an overall average of 1005 pounds. Lint percentages, staple lengths, fiber strengths, and micronaire indexes were about normal for the varieties planted.

### Averages

Tables 1 through 4 present the results of the 4 variety-yield trials. Yield of seed cotton and lint, lint percentage, earliness, and fiber properties of staple length, strength ($T_1$), and micronaire are given Gross money value per acre for each variety was computed by using the Credit Commodity Corporation loan prices for Strict Low Middling grade, for the staple length of the variety times the pounds of lint per acre, plus the seed at $54 a ton. Varieties are listed in each table in order of dollar value per acre. This order follows closely the yields of lint per acre, with few exceptions.

Table 5 shows the average lint percentages, earliness, staple lengths, fiber strengths, and micronaires for 15 varieties for all tests. Lint percentages were lower than in 1960. Earliness averages showed Stoneville 3202, Rex, and Empire to be the earliest varieties. Staple lengths were longer in 1961, ranging from 1 1/32+ for Stoneville 3202 to 1 3/32+ for Delfos 9169. The other varieties classed 1 1/16 and 1 3/32. Fiber strength or tenacity ($T_1$), as determined by the Stelometer at 1/8-inch gauge, as relative. By this measure Stardel, Deltapine 15, and D&PL Smooth Leaf have stronger fiber than do the other varieties. Stoneville 3202 and Rex have relatively weak fiber. Fineness, as measured by the micronaire, ranged from 3.85 for Empire and 3.90 for Delfos 9169 and Rex to the coarser-fibered Fox 4 and Stoneville 7. All varieties had lower micronaires in 1961 than in 1960 and

## Stoneville

**Table 1.—Yield, gin turn out, earliness, boll size, staple length, strength, elongation, micronaire, and gross value per acre for the 1961 cotton variety test at Stoneville, Mississippi.**

| | Yield per acre | | | Percent at | Number bolls per pound | | Fiber Properties | | | | | Gross value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seed | | Percent | first | Seed | | Staple length | | Strength | Elongation | Micro- | per acre |
| Variety | cotton | Lint | lint | pick | cotton | Lint | Classer | UHM | $T_1$ | $E_1$ | naire | SLM |
| | lbs. | lbs. | pct. | pct. | no. | no. | inch | inch | index | index | index | dollars |
| D&PL Smooth Leaf | 3125 | 1150 | 36.8 | 52 | 71 | 194 | 1 3/32 | 1.22 | 2.00 | 9.0 | 4.30 | $428 |
| DeKalb 108 | 3253 | 1122 | 34.5 | 55 | 53 | 154 | 1 3/32 | 1.23 | 1.91 | 7.7 | 3.95 | 423 |
| DeKalb 220 | 3238 | 1120 | 34.6 | 60 | 57 | 192 | 1 3/32 | 1.22 | 1.93 | 7.5 | 4.25 | 422 |
| Auburn 56 | 3260 | 1115 | 34.2 | 52 | 59 | 170 | 1 3/32— | 1.20 | 1.90 | 7.9 | 4.38 | 420 |
| Stoneville 7 | 3089 | 1121 | 36.3 | 53 | 64 | 178 | 1 3/32— | 1.20 | 1.90 | 7.2 | 4.77 | 418 |
| Coker 100A | 3098 | 1109 | 35.8 | 53 | 63 | 170 | 1 3/32 | 1.23 | 1.88 | 7.3 | 4.38 | 415 |
| Stoneville 3202 | 3006 | 1094 | 36.4 | 71 | 64 | 177 | 1 1/16 | 1.12 | 1.75 | 7.5 | 4.38 | 405 |
| Stardel | 3075 | 1070 | 34.8 | 52 | 72 | 205 | 1 1/8— | 1.18 | 2.09 | 6.8 | 4.10 | 404 |
| Rex | 3066 | 1070 | 34.9 | 61 | 63 | 181 | 1 3/32— | 1.18 | 1.82 | 7.1 | 3.90 | 401 |
| Acala 4-42 | 2911 | 1039 | 35.7 | 58 | 55 | 154 | 1 1/8— | 1.19 | 2.35 | 7.1 | 3.93 | 390 |
| Empire | 3120 | 1017 | 32.6 | 58 | 51 | 154 | 1 3/32 | 1.21 | 1.85 | 6.2 | 3.64 | 388 |
| Delta Queen | 2877 | 1027 | 35.7 | 53 | 60 | 168 | 1 3/32 | 1.24 | 1.97 | 7.4 | 4.35 | 385 |
| Dixie King | 2857 | 994 | 34.8 | 51 | 51 | 147 | 1 3/32 | 1.21 | 1.97 | 6.2 | 4.39 | 374 |
| Delfos 9169 | 2933 | 971 | 33.1 | 57 | 57 | 171 | 1 1/8— | 1.26 | 1.90 | 7.0 | 4.02 | 370 |
| Fox 4 | 2819 | 984 | 34.9 | 56 | 67 | 190 | 1 3/32 | 1.18 | 2.00 | 6.5 | 5.04 | 370 |
| Deltapine 15 | 2555 | 933 | 36.5 | 45 | 71 | 195 | 1 3/32— | 1.21 | 2.00 | 8.2 | 4.12 | 347 |
| Lankart 57 | 2255 | 764 | 33.9 | 50 | 46 | 140 | 1 1/32 | 1.14 | 1.63 | 8.6 | 4.48 | 283 |
| Averages | 2917 | 1026 | 35.2 | 54 | | | | | | | | |
| LSD at 5% level | | 119 | | | | | | | | | | |

Planted May 10; harvested October 12 and November 28.

## Tunica

Table 2.—Yield, gin turn out, earliness, staple length, strength, elongation, micronaire, and gross value per acre for the 1961 cotton variety test at Tunica, Mississippi

| Variety | Yield per acre<br>Seed cotton | Yield per acre<br>Lint | Percent lint | Percent at first pick | Fiber Properties<br>Staple length<br>Classer | Fiber Properties<br>Staple length<br>UHM | Fiber Properties<br>Strength<br>$T_1$ | Fiber Properties<br>Elongation<br>$E_1$ | Fiber Properties<br>Micro-naire | Gross value per acre SLM |
|---|---|---|---|---|---|---|---|---|---|---|
| | lbs. | lbs. | pct. | pct. | inch | inch | index | index | index | dollars |
| Stoneville 3202 | 3079 | 1145 | 37.2 | 50 | 1 1/16 | 1.08 | 1.57 | 6.7 | 3.98 | $422 |
| DeKalb 108 | 3068 | 1083 | 35.3 | 39 | 1 3/32 | 1.07 | 1.85 | 6.3 | 4.05 | 407 |
| Delfos 9169 | 3098 | 1056 | 34.1 | 39 | 1 1/8 | 1.25 | 1.79 | 6.8 | 3.87 | 402 |
| Coker 100A | 2907 | 1052 | 36.2 | 42 | 1 3/32 | 1.20 | 1.75 | 6.5 | 3.88 | 393 |
| Empire | 2945 | 1057 | 35.9 | 57 | 1 1/16 | 1.15 | 1.75 | 5.7 | 3.84 | 392 |
| Fox 4 | 2929 | 1034 | 35.3 | 43 | 1 3/32 | 1.17 | 1.94 | 5.9 | 4.28 | 388 |
| Delta Queen | 2872 | 1031 | 35.9 | 33 | 1 3/32 | 1.21 | 1.84 | 6.4 | 4.13 | 386 |
| Dixie King | 2825 | 1028 | 36.4 | 43 | 1 3/32— | 1.18 | 1.71 | 5.5 | 3.84 | 382 |
| DeKalb 220 | 2807 | 1000 | 35.6 | 38 | 1 3/32— | 1.21 | 1.80 | 5.9 | 3.90 | 373 |
| Stoneville 7 | 2776 | 1000 | 36.0 | 34 | 1 1/16 | 1.15 | 1.82 | 6.3 | 4.65 | 371 |
| Auburn 56 | 2812 | 979 | 34.8 | 40 | 1 3/32— | 1.16 | 1.82 | 7.1 | 3.78 | 367 |
| D&PL Smooth Leaf | 2646 | 984 | 37.2 | 39 | 1 3/32— | 1.16 | 1.90 | 8.0 | 4.24 | 364 |
| Rex | 2730 | 972 | 35.6 | 54 | 1 1/16 | 1.16 | 1.64 | 6.6 | 3.64 | 361 |
| Acala 4 - 42 | 2480 | 908 | 36.6 | 39 | 1 3/32 | 1.16 | 2.20 | 6.3 | 4.23 | 338 |
| Stardel | 2306 | 853 | 37.0 | 39 | 1 1/16 | 1.20 | 1.90 | 5.6 | 4.37 | 315 |
| Deltapine 15 | 2175 | 818 | 37.6 | 35 | 1 3/32— | 1.17 | 1.92 | 7.2 | 3.91 | 302 |
| Lankart 57 | 1963 | 700 | 35.6 | 34 | 1 1/32 | 1.12 | 1.68 | 8.3 | 4.25 | 257 |
| Averages | 2688 | 969 | 36.1 | 41 | | | | | | |
| LSD at 5% level | | 132 | | | | | | | | |

Planted May 12; harvested October 6 and November 9.

## Clarksdale

**Table 3.—Yield gin turn out, earliness, staple length, strength, elogation, and gross value per acre for the 1961 cotton variety test at Clarksdale, Mississippi**

| Variety | Yield per acre | | Percent | Percent at | Fiber Properties | | | | | Gross value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Seed cotton | Lint | lint | first pick | Staple length Classer | UHM | Strength $T_1$ | Elongation $E_1$ | Micro-naire | per acre SLM |
| | lbs. | lbs. | pct. | pct. | inch | inch | index | index | index | dollars |
| Stoneville 3202 | 2766 | 1000 | 36.2 | 55 | 1 1/16— | 1.08 | 1.60 | 7.2 | 3.80 | $368 |
| Rex | 2776 | 933 | 33.6 | 60 | 1 1/16 | 1.17 | 1.73 | 7.0 | 3.64 | 351 |
| DeKalb 220 | 2678 | 919 | 34.3 | 54 | 1 1/16 | 1.19 | 1.77 | 7.1 | 3.88 | 344 |
| Coker 100 A | 2545 | 898 | 35.3 | 50 | 1 3/32 | 1.22 | 1.72 | 7.0 | 4.28 | 337 |
| D&PL Smooth Leaf | 2450 | 900 | 36.7 | 48 | 1 1/16 | 1.17 | 1.94 | 9.0 | 4.05 | 332 |
| Auburn 56 | 2654 | 889 | 33.5 | 43 | 1 1/16— | 1.15 | 1.77 | 7.7 | 3.64 | 332 |
| Stoneville 7 | 2526 | 882 | 34.9 | 40 | 1 3/32— | 1.20 | 1.84 | 7.1 | 4.22 | 330 |
| Empire | 2632 | 879 | 33.4 | 54 | 1 1/16— | 1.16 | 1.75 | 6.4 | 3.70 | 329 |
| DeKalb 108 | 2482 | 856 | 34.5 | 48 | 1 1/16 | 1.17 | 1.80 | 6.6 | 3.96 | 320 |
| Dixie King | 2453 | 834 | 34.0 | 45 | 1 1/16 | 1.16 | 1.81 | 6.1 | 3.93 | 313 |
| Fox 4 | 2349 | 808 | 34.4 | 45 | 1 1/16— | 1.18 | 1.86 | 7.1 | 4.18 | 301 |
| Delta Queen | 2319 | 793 | 34.2 | 39 | 1 3/32— | 1.22 | 1.84 | 6.8 | 4.10 | 298 |
| Delfos 9169 | 2314 | 773 | 33.4 | 50 | 1 3/32 | 1.22 | 1.75 | 7.3 | 3.66 | 293 |
| Deltapine 15 | 2118 | 767 | 36.2 | 40 | 1 1/16 | 1.17 | 1.90 | 8.0 | 3.90 | 284 |
| Stardel | 1800[1] | 646 | 35.9 | 51 | 1 3/32— | 1.18 | 2.12 | 5.9 | 3.85 | 241 |
| Averages | 2426 | 843 | 34.7 | 48 | | | | | | |
| LSD at 5% level | | 165 | | | | | | | | |

Planted April 28; harvested October 10 and November 10.

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[1] Damaged by Verticillium wilt.

## Yazoo City

Table 4.—Yield, gin turn out, earliness, staple length, strength, elongation, micronaire, and gross value per acre for the 1961 cotton variety test at Yazoo City, Mississippi.

| Variety | Yield per acre Seed cotton | Yield per acre Lint | Percent lint | Percent at first pick | Fiber Properties Staple length Classer | Fiber Properties Staple length UHM | Strength T₁ | Elongation E₁ | Micronaire | Gross value per acre SLM |
|---|---|---|---|---|---|---|---|---|---|---|
| | lbs. | lbs. | pct. | pct. | inch | inch | index | index | index | dollars |
| Stoneville 3202 | 3140 | 1200 | 38.2 | 41 | 1 1/32 | 1.07 | 1.58 | 7.3 | 4.47 | $434 |
| Rex | 3136 | 1110 | 35.4 | 41 | 1 1/16 | 1.13 | 1.66 | 6.5 | 4.40 | 413 |
| DeKalb 220 | 2987 | 1087 | 36.4 | 39 | 1 1/16 | 1.15 | 1.79 | 6.2 | 4.52 | 402 |
| Delta Queen | 3017 | 1070 | 35.5 | 26 | 1 3/32— | 1.20 | 1.85 | 6.5 | 4.40 | 400 |
| D&PL Smooth Leaf | 2759 | 1076 | 39.0 | 33 | 1 1/16 | 1.14 | 1.92 | 7.8 | 4.53 | 393 |
| DeKalb 108 | 2926 | 1039 | 35.5 | 37 | 1 1/16 | 1.17 | 1.77 | 6.8 | 4.40 | 387 |
| Stardel | 2744 | 1032 | 37.6 | 25 | 1 3/32 | 1.12 | 1.98 | 5.7 | 5.00 | 380 |
| Stoneville 7 | 2675 | 995 | 37.2 | 29 | 1 1/16 | 1.14 | 1.78 | 6.5 | 5.10 | 367 |
| Empire | 2788 | 973 | 34.9 | 44 | 1 1/16— | 1.12 | 1.83 | 5.9 | 4.20 | 361 |
| Dixie King | 2679 | 967 | 36.1 | 41 | 1 1/16 | 1.16 | 1.78 | 5.8 | 4.63 | 359 |
| Fox 4 | 2661 | 950 | 35.7 | 28 | 1 1/16 | 1.13 | 1.98 | 6.4 | 5.14 | 353 |
| Delfos 9169 | 2693 | 918 | 34.1 | 27 | 1 3/32 | 1.22 | 1.74 | 7.3 | 4.09 | 344 |
| Auburn 56 | 2672 | 922 | 34.5 | 24 | 1 1/16— | 1.14 | 1.75 | 6.3 | 4.52 | 343 |
| Coker 100A | 2483 | 910 | 36.7 | 34 | 1 1/16 | 1.16 | 1.70 | 6.9 | 4.52 | 337 |
| Deltapine 15 | 2316 | 904 | 39.0 | 21 | 1 1/16 | 1.10 | 2.10 | 6.9 | 4.70 | 330 |
| Averages | 2755 | 1005 | 36.5 | 34 | | | | | | |
| LSD | | 141 | | | | | | | | |

Planted April 26; harvested September 20 and November 2.

are in the desirable range for mill use.

Yield data and earliness were obtained from replicated and randomized plots in each test. Other data were determined from samples taken from the plots at first harvest. Classing was done by the Staple Cotton Cooperative Association in Greenwood, Mississippi, and the fiber properties data were determined by the fiber laboratory of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture at Knoxville, Tennessee.

**Table 5.—Average lint percent, earliness, classer's staple length, upper half mean, fiber strength, and micronaire for 15 varieties of cotton grown at four Delta locations in 1961.**

| Variety | Lint percent | Earliness[1] | Classer's staple length | Upper half mean | Fiber strength $T_1$ | Micronaire |
|---|---|---|---|---|---|---|
| | percent | percent | inches | inches | inches | inches |
| Auburn 56 | 34.3 | 40 | 1 1/16 | 1.16 | 1.81 | 4.08 |
| Coker 100 A | 36.0 | 45 | 1 3/32 | 1.20 | 1.76 | 4.27 |
| Delta Queen | 35.3 | 38 | 1 3/32 | 1.22 | 1.88 | 4.25 |
| Delfos 9169 | 33.7 | 43 | 1 3/32+ | 1.24 | 1.80 | 3.91 |
| Deltapine 15 | 37.3 | 35 | 1 1/16+ | 1.16 | 1.98 | 4.16 |
| D&PL Smooth Leaf | 37.4 | 43 | 1 1/16+ | 1.17 | 1.94 | 4.28 |
| DeKalb 108 | 35.0 | 45 | 1 1/16+ | 1.17 | 1.83 | 4.09 |
| DeKalb 220 | 35.3 | 48 | 1 1/16+ | 1.19 | 1.82 | 4.14 |
| Dixie King | 35.3 | 45 | 1 1/16+ | 1.18 | 1.82 | 4.20 |
| Empire | 34.2 | 53 | 1 1/16 | 1.16 | 1.80 | 3.85 |
| Fox 4 | 35.0 | 43 | 1 1/16+ | 1.17 | 1.95 | 4.66 |
| Rex | 34.9 | 54 | 1 1/16 | 1.16 | 1.71 | 3.90 |
| Stardel | 36.3 | 42 | 1 3/32 | 1.17 | 2.02 | 4.33 |
| Stoneville 7 | 36.1 | 39 | 1 1/16+ | 1.17 | 1.84 | 4.68 |
| Stoneville 3202 | 37.0 | 54 | 1 1/32+ | 1.09 | 1.63 | 4.16 |

[1] Percentage of total yield harvested at the first picking.

## COTTON TESTS IN HILL SECTIONS

The highest yielding varieties in these Hill Section tests averaged 842 pounds of lint per acre in 1961 and the lowest ones 574 pounds, or a difference of 268 pounds. Using the loan price for Strict Low Middling cotton, the average difference in value between the highest and lowest yielding varieties was $95 per acre.

For the last 3 to 5 years at the six locations where these figures were available, the difference in yield between the highest and lowest varieties averaged 115 pounds of lint per acre valued at $38.

These figures plus the fact that more than one and a half million acres of cotton are planted each year in Mississippi show the value of the Experiment Station cotton variety testing program. Of the sixteen commercial varieties in these tests, three were included for the first time and five have been in the tests less than five years.

Yields ranged from very good in the tests at Holly Springs and Pontotoc to good at Brooksville and fair at State College and Newton.

Seven variety trials were completed at five hill stations in 1961. These consisted of one test at the Central Station, State College, one on flatwood soil and one on Pontotoc Ridge soil at the Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, one on bottom land on a private farm and one on upland on the station at the North Mississippi Branch Station, Holly Springs, one each at the Black Belt Branch Station, Brooksville and the Coastal Plain Branch Station, Newton. Boll development was very irregular due to flooding and insect damage in the test at the

Northeast Mississippi Branch Station, Verona. The stand was poor and very irregular in the test at the Brown Loam Branch Station, Raymond. Therefore, neither of the latter two tests was harvested for yield records.

Cool, wet weather in the spring resulted in delayed planting, poor seed germination and high losses of young plants from disease at most locations. The crop was late and generally had very few bottom bolls. Thrips infestation was high at State College. Boll weevils damaged the crop at Newton due to excessive rain during the heavy fruiting period.

Final stands were from fair to good except at Raymond and State College. The tests were planted over at State College, Newton and in the bottom land test at Holly Springs. The stand at State College was poor and of different ages due to a dry spell following the second planting.

Twenty five varieties and commercial breeders strains were in the test at State College. Sixteen of these were in the other tests. These are standard varieties and seed should be available. Stoneville 7A, Delta Queen and DeKalb 220 are new varieties. New varieties are generally included if seed are made available by the breeders.

Seed were furnished by the breeders of the varieties except those of Deltapine 15, Coker 100A, Acala 4-42 and Lankart 57 planted at State College which were supplied from the Delta Branch Station at Stoneville as National Entries in a beltwide variety test in which this station is cooperating. Seed were planted in the condition in which they were received and all had been delinted and treated.

Tests were planted in randomized blocks and consisted of six replications except those at the North Mississippi Branch Station at Holly Springs had eight. One replication at State College was not used because of severe wilt damage in it in some varieties. The plots were single rows varying from 60 to 185 feet in length and 36 to 42 inches in width.

Lint percentage and boll size were determined from 100 boll samples from each variety in each of three replications. Lint samples for staple length determinations came from these same samples. For the 100 boll samples, only well developed bolls were carefully hand picked before much exposure to weather. Consequently the figures on lint percentage, boll size, and staple length can only be used in comparing one variety with another. These characteristics will vary greatly depending on soil, season, cleanliness of seed cotton, the amount of faulty bolls, etc.

The staple lengths reported are averages of the determinations of three professional cotton classers each representing a different organization and stapling samples from a different replication.

The value per acre is the value of lint and seed. Strict Low Middling was used since it is close to the average grade of the crop in the hill section of Mississippi. Seed were figured at $50 per ton and lint at the loan price for SLM cotton of the staple length of that variety in that test. Corrections for skips were made for the excess over three feet per skip. The percent picked at the first picking as an indication of earliness was determined at Brooksville, Newton and Holly Springs.

Most of the varieties in these tests are good. One should be able to select a good variety by studying the averages table from the station with conditions most nearly like his own with some consideration of the latest results on new varieties.

Averaging the average yields from seven locations shows the five highest yielding varieties with their respective lint yields per acre to be Auburn 56 with 667 pounds, Stoneville 3202 with 652 pounds, Dixie King with 648 pounds, Plains 637 pounds and Empire 625 pounds. Coker 100A, Rex, DeKalb 108, Deltapine Smooth Leaf, Fox 4, DeKalb 220 and Delta Queen each did well in one or more tests in 1961.

Of the 16 varieties common to all the

tests, the Deltapines, Fox 4, the Stonevilles, Delfos 9169 and DeKalb 220 supposedly have least resistance to Fusarium wilt. Auburn 56, Plains, Coker 100A and probably DeKalb 108 supposedly have the highest resistance to this disease. None have much resistance to Verticillium wilt.

Data on yields, values and other characteristics are shown in the tables. Delta-

## State College

**Cotton Variety Averages, Central Station State College**

| Variety | Yield per acre, pounds lint 1957 | 1958 | 1959 | 1960 | 1961 | Ave. | Averages Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
|---|---|---|---|---|---|---|---|---|---|---|
| Empire | 604 | 358 | 735 | 761 | 566 | 605 | 215 | 36.7 | 34.3 | 147 |
| Plains | 536 | 409 | 702 | 746 | 597 | 598 | 212 | 36.8 | 34.1 | 170 |
| Stoneville 7 | 522 | 348 | 799 | 772 | 536 | 595 | 210 | 38.5 | 34.5 | 185 |
| Delfos 9169 | 488 | 352 | 777 | 853 | 485 | 591 | 215 | 35.3 | 35.5 | 171 |
| Deltapine SL | 608 | 441 | 635 | 772 | 499 | 591 | 209 | 38.9 | 34.7 | 187 |
| Stoneville 3202 | 544 | 405 | 685 | 741 | 562 | 587 | 206 | 38.4 | 33.5 | 185 |
| Dixie King | 582 | 403 | 688 | 756 | 490 | 584 | 208 | 37.1 | 34.2 | 150 |
| Auburn 56 | 537 | 399 | 700 | 713 | 561 | 582 | 208 | 35.5 | 34.3 | 189 |
| Deltapine 15 | 520 | 412 | 612 | 675 | 512 | 546 | 193 | 39.4 | 34.6 | 184 |
| Rex | —— | 430 | 717 | 751 | 584 | | | | | |
| Coker 100A | —— | —— | 755 | 748 | 559 | | | | | |
| Fox 4 | —— | —— | 634 | 700 | 535 | | | | | |
| DeKalb 108 | —— | —— | —— | 748 | 576 | | | | | |
| Acala 4-42 | —— | —— | —— | 792 | 530 | | | | | |
| All-In-One | —— | —— | —— | 699 | 566 | | | | | |
| Lankart 57 | —— | —— | —— | 695 | 320 | | | | | |

**Cotton Varieties, Central Station, State College, 1961.**

| Variety | Yield per a., lbs Seed cotton | Lint | Dollar val. per a. SLM | Lint % | Staple 32nds. inch | Bolls per lb. Seed cotton | Lint |
|---|---|---|---|---|---|---|---|
| Plains | 1668 | 597 | 220 | 35.8 | 34.7 | 62 | 172 |
| Rex | 1582 | 584 | 211 | 36.9 | 33.7 | 61 | 167 |
| DeKalb 108 | 1599 | 576 | 212 | 36.0 | 34.7 | 59 | 164 |
| All-In-One | 1594 | 566 | 209 | 35.5 | 34.3 | 57 | 161 |
| Empire | 1542 | 566 | 207 | 36.7 | 34.7 | 51 | 139 |
| Stoneville 3202 | 1502 | 562 | 205 | 37.4 | 34.3 | 70 | 187 |
| Auburn 56 | 1625 | 561 | 208 | 34.5 | 34.7 | 67 | 194 |
| Coker 100A | 1523 | 559 | 205 | 36.7 | 34.7 | 67 | 181 |
| Stoneville 7A | 1440 | 549 | 201 | 38.1 | 35.3 | 70 | 183 |
| Delta Queen | 1540 | 547 | 203 | 35.5 | 35.0 | 64 | 180 |
| Stoneville 7 | 1407 | 536 | 196 | 38.1 | 35.7 | 67 | 176 |
| Fox 4 | 1487 | 535 | 197 | 36.0 | 34.7 | 67 | 185 |
| DeKalb 220 | 1468 | 533 | 197 | 36.3 | 35.3 | 62 | 171 |
| Acala 4-42 | 1395 | 530 | 193 | 38.0 | 34.0 | 55 | 145 |
| Deltapine 15 | 1357 | 512 | 188 | 37.7 | 35.3 | 72 | 190 |
| Stoneville 213 | 1312 | 502 | 183 | 38.3 | 34.7 | 71 | 187 |
| Deltapine SL | 1323 | 499 | 183 | 37.7 | 35.7 | 69 | 184 |
| Dixie King | 1354 | 490 | 180 | 36.2 | 34.0 | 53 | 145 |
| 5479-57-61-74 | 1345 | 488 | 179 | 36.3 | 34.7 | 66 | 181 |
| Coker 137-62 | 1283 | 488 | 178 | 38.0 | 34.3 | 70 | 184 |
| Delfos 9169 | 1426 | 485 | 182 | 34.0 | 35.0 | 58 | 171 |
| Dixie King 48A | 1226 | 467 | 170 | 38.1 | 34.3 | 55 | 144 |
| K7 (Emp. Der.) | 1293 | 460 | 171 | 35.6 | 35.3 | 56 | 158 |
| Empire 61A | 1209 | 447 | 164 | 37.0 | 34.3 | 54 | 145 |
| Lankart 57 | 910 | 320 | 116 | 35.2 | 33.0 | 51 | 146 |
| LSD 5% | 236 | 87 | | | | | |
| CV 13.5% | | | | | | | |

Soil: Verona fine sandy loam. Fertilizers: 72-48-48. Planted over: May 13. Poisoned: 12 times.

pine SL means Deltapine Smooth Leaf. The term LSD at 5% means that the odds are 19 to 1 that differences between varieties less than this amount are not real differences in yielding ability statistically. CV means coefficient of variation and the smaller it is the better the test. A blank space in the averages tables means the variety was not in the test that year or the full number of years.

## Black Belt

**Cotton Variety Averages, Black Belt Branch Station, Brooksville**

| | Yield per acre, pounds lint | | | | Averages | | | |
|---|---|---|---|---|---|---|---|---|
| Variety | 1959 | 1960 | 1961 | Ave. | Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
| Stoneville 3202 | 845 | 577 | 756 | 726 | 249 | 39.3 | 32.9 | 215 |
| Plains | 854 | 577 | 710 | 714 | 249 | 37.6 | 34.0 | 197 |
| Empire | 795 | 629 | 707 | 710 | 251 | 37.9 | 34.4 | 172 |
| Auburn 56 | 817 | 582 | 709 | 703 | 245 | 37.4 | 33.8 | 213 |
| Rex | 784 | 675 | 632 | 697 | 242 | 38.9 | 34.2 | 185 |
| Dixie King | 836 | 610 | 606 | 684 | 240 | 38.1 | 34.5 | 172 |
| Coker 100A | 717 | 616 | 710 | 681 | 240 | 38.2 | 34.6 | 208 |
| Deltapine SL | 778 | 590 | 600 | 656 | 228 | 40.2 | 34.3 | 219 |
| Fox 4 | 728 | 590 | 630 | 649 | 226 | 38.8 | 34.1 | 215 |
| Delfos 9169 | 693 | 615 | 585 | 631 | 228 | 35.9 | 35.4 | 208 |
| Deltapine 15 | 750 | 564 | 468 | 594 | 207 | 40.0 | 34.6 | 221 |
| Stoneville 7 | 827 | 683 | | | | | | |
| DeKalb 108 | —— | 630 | 799 | | | | | |
| All-In-One | —— | 536 | 554 | | | | | |

**Cotton Varieties, Black Belt Branch Station, Brooksville, 1961**

| | Yield per a., lbs. | | Dollar | | Staple | Bolls per lb. | | % |
|---|---|---|---|---|---|---|---|---|
| Variety | Seed cotton | Lint | val. per a., SLM | Lint % | 32nds. inch | Seed cotton | Lint | first picking |
| DeKalb 108 | 2075 | 799 | 290 | 38.5 | 34.7 | 71 | 184 | 69 |
| Stoneville 3202 | 1918 | 756 | 269 | 39.4 | 33.3 | 76 | 192 | 68 |
| DeKalb 220 | 1813 | 745 | 269 | 41.1 | 35.0 | 74 | 181 | 65 |
| Plains | 1864 | 710 | 254 | 38.1 | 33.7 | 69 | 182 | 52 |
| Coker 100A | 1850 | 710 | 260 | 38.4 | 35.0 | 76 | 197 | 58 |
| Auburn 56 | 1881 | 709 | 255 | 37.7 | 33.7 | 75 | 199 | 62 |
| Empire | 1865 | 707 | 259 | 37.9 | 35.0 | 67 | 176 | 72 |
| Delta Queen | 1674 | 653 | 238 | 39.0 | 35.3 | 75 | 192 | 62 |
| Rex | 1634 | 632 | 229 | 38.7 | 34.3 | 72 | 185 | 80 |
| Fox 4 | 1540 | 630 | 226 | 40.9 | 34.3 | 80 | 195 | 68 |
| Dixie King | 1565 | 606 | 320 | 38.7 | 34.7 | 62 | 159 | 56 |
| Deltapine SL | 1477 | 600 | 216 | 40.6 | 34.7 | 86 | 212 | 55 |
| Stoneville 7A | 1462 | 588 | 212 | 40.2 | 34.3 | 77 | 192 | 60 |
| Delfos 9169 | 1611 | 585 | 216 | 36.3 | 35.0 | 75 | 205 | 52 |
| All-In-One | 1470 | 554 | 202 | 37.7 | 34.0 | 72 | 191 | 64 |
| Deltapine 15 | 1166 | 468 | 169 | 40.1 | 34.7 | 94 | 235 | 55 |
| LSD 5% | 176 | 69 | | | | | | |
| CV 9.4% | | | | | | | | |

Soil: Houston Clay. Fertilizer: 50-60-40 preplant plus 50 pounds N side dressing. Planted: April 19. Poisoned: 7 times.

## Newton

### Cotton Variety Averages, Coastal Plain Branch Station, Newton

| Variety | Yield pre acre, pounds lint 1957 | 1958 | 1959 | 1960 | 1961 | Ave. | Averages: Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
|---|---|---|---|---|---|---|---|---|---|---|
| Auburn 56 | 508 | 270 | 623 | 545 | 496 | 489 | 171 | 36.9 | 33.3 | 189 |
| Dixie King | 487 | 220 | 589 | 549 | 432 | 455 | 158 | 38.3 | 33.5 | 152 |
| Plains | 476 | 246 | 541 | 515 | 496 | 455 | 158 | 37.7 | 33.2 | 176 |
| Stoneville 3202 | 485 | 212 | 585 | 516 | 459 | 451 | 155 | 39.3 | 32.7 | 197 |
| Deltapine SL | 398 | 204 | 586 | 492 | 472 | 431 | 150 | 39.8 | 33.7 | 199 |
| Empire | 496 | 221 | 498 | 446 | 392 | 411 | 143 | 37.7 | 33.3 | 153 |
| Deltapine 15 | 401 | 165 | 521 | 519 | 353 | 392 | 134 | 39.7 | 33.1 | 198 |
| Delfos 9169 | 405 | 127 | 528 | 502 | 364 | 385 | 137 | 36.6 | 34.9 | 184 |
| Rex | —— | 295 | 589 | 590 | 560 | | | | | |
| Stoneville 7 | 461 | 180 | 590 | 560 | —— | | | | | |
| Pope | 540 | 250 | 537 | 560 | —— | | | | | |
| Coker 100A | —— | —— | 566 | 502 | 441 | | | | | |
| Fox 4 | —— | —— | 543 | 493 | 451 | | | | | |
| DeKalb 108 | —— | —— | —— | 535 | 473 | | | | | |
| All-In-One | —— | —— | —— | 467 | 419 | | | | | |

### Cotton Varieties, Coastal Plain Branch Station, Newton, 1961.

| Variety | Yield per a., lbs. Seed cotton | Lint | Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. Seed cotton | Lint | % first picking |
|---|---|---|---|---|---|---|---|---|
| Rex | 1489 | 560 | 201 | 37.6 | 33.7 | 60 | 160 | 82 |
| Auburn 56 | 1345 | 496 | 179 | 36.9 | 33.3 | 66 | 179 | 77 |
| Plains | 1318 | 496 | 178 | 37.6 | 33.3 | 63 | 168 | 76 |
| DeKalb 220 | 1280 | 492 | 176 | 38.4 | 33.3 | 64 | 166 | 75 |
| DeKalb 108 | 1247 | 473 | 172 | 37.9 | 34.7 | 62 | 164 | 78 |
| Deltapine SL | 1160 | 472 | 167 | 40.7 | 33.3 | 74 | 181 | 69 |
| Stoneville 7A | 1303 | 468 | 167 | 38.9 | 33.7 | 70 | 180 | 72 |
| Stoneville 3202 | 1157 | 459 | 160 | 39.7 | 32.3 | 74 | 186 | 83 |
| Fox 4 | 1184 | 451 | 162 | 38.1 | 33.3 | 70 | 184 | 77 |
| Delta Queen | 1157 | 443 | 159 | 38.3 | 33.3 | 67 | 174 | 76 |
| Coker 100A | 1124 | 441 | 160 | 39.2 | 34.0 | 69 | 176 | 80 |
| Dixie King | 1102 | 432 | 154 | 39.2 | 33.3 | 55 | 139 | 80 |
| All-In-One | 1130 | 419 | 151 | 37.1 | 33.3 | 61 | 164 | 74 |
| Empire | 1064 | 392 | 144 | 36.8 | 34.0 | 55 | 150 | 86 |
| Delfos 9169 | 1018 | 364 | 135 | 35.8 | 35.0 | 64 | 180 | 79 |
| Deltapine 15 | 877 | 353 | 125 | 40.3 | 33.0 | 78 | 193 | 73 |
| LSD 5% | 248 | 96 | | | | | | |
| CV 18.9% | | | | | | | | |

Soil: Prentiss fine sandy loam. Fertilizer: 72-72-72
Planted: over: May 18. Poisoned: 14 times.

## Brown Loam

### Cotton Variety Averages, Brown Loam Branch Station, Raymond

| Variety | Yield per acre, pounds lint 1955 | 1956 | 1957 | 1960 | Ave. | Averages: Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
|---|---|---|---|---|---|---|---|---|---|
| Auburn 56 | 759 | 497 | 983 | 474 | 678 | 247 | 35.2 | 33.8 | 208 |
| Empire | 702 | 550 | 864 | 488 | 651 | 233 | 37.4 | 33.5 | 158 |
| Deltapine 15 | 816 | 403 | 735 | 614 | 642 | 230 | 38.6 | 33.7 | 204 |
| Dixie King | 714 | 552 | 735 | 541 | 635 | 226 | 37.0 | 33.4 | 160 |
| Plains | 781 | 502 | 694 | 489 | 616 | 219 | 36.8 | 33.0 | 194 |
| Stoneville 3202 | 736 | 461 | 729 | 532 | 614 | 210 | 38.4 | 31.6 | 209 |
| Delfos 9169 | 745 | 414 | 599 | 465 | 556 | 204 | 36.1 | 34.7 | 194 |
| Pope | —— | 501 | 836 | 503 | | | | | |
| Stoneville 7 | —— | 442 | 741 | 607 | | | | | |
| Deltapine SL | —— | —— | 869 | 575 | | | | | |

## Pontotoc

### Cotton Variety Averages, Flatwoods, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

| | Yield per acre, pounds lint | | | | Averages | | | |
|---|---|---|---|---|---|---|---|---|
| Variety | 1959 | 1960 | 1961 | Ave. | Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
| Rex | 710 | 530 | 777 | 672 | 238 | 40.5 | 33.5 | 159 |
| Coker 100A | 686 | 466 | 853 | 668 | 238 | 39.4 | 33.8 | 180 |
| Auburn 56 | 733 | 491 | 766 | 663 | 236 | 37.9 | 33.3 | 186 |
| Dixie King | 735 | 505 | 738 | 659 | 236 | 39.0 | 33.8 | 146 |
| Soneville 3202 | 694 | 448 | 818 | 653 | 226 | 40.7 | 32.7 | 187 |
| Empire | 720 | 456 | 774 | 650 | 232 | 39.5 | 33.4 | 138 |
| Deltapine SL | 683 | 495 | 721 | 633 | 222 | 40.8 | 33.3 | 191 |
| Plains | 732 | 440 | 678 | 617 | 219 | 38.6 | 33.7 | 175 |
| Fox 4 | 660 | 458 | 663 | 594 | 211 | 38.8 | 33.2 | 190 |
| Delfos 9169 | 659 | 408 | 627 | 565 | 206 | 37.4 | 34.9 | 171 |
| Deltapine 15 | 585 | 395 | 639 | 540 | 191 | 40.8 | 33.4 | 189 |
| DeKalb 108 | —— | 499 | 790 | | | | | |
| Stoneville 7 | 707 | 465 | —— | | | | | |
| All-In-One | —— | 435 | 659 | | | | | |

### Cotton Varieties, Flatwood Soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1961.

| | Yield per a., lbs | | Dollar | | Staple | Bolls per lb. | |
|---|---|---|---|---|---|---|---|
| Variety | Seed cotton | Lint | val. per a. SLM | Lint % | 32nds. inch | Seed cotton | Lint |
| Coker 100A | 2116 | 853 | 303 | 40.3 | 33.7 | 65 | 162 |
| Soneville 3202 | 2015 | 818 | 284 | 40.6 | 32.7 | 71 | 174 |
| DeKalb 108 | 2051 | 790 | 287 | 38.5 | 34.0 | 60 | 156 |
| Delta Queen | 2015 | 786 | 285 | 39.0 | 34.0 | 67 | 171 |
| DeKalb 220 | 2004 | 784 | 280 | 39.1 | 33.0 | 62 | 159 |
| Rex | 1938 | 777 | 276 | 40.1 | 33.3 | 59 | 148 |
| Empire | 1975 | 774 | 276 | 39.2 | 33.3 | 53 | 135 |
| Auburn 56 | 2011 | 766 | 275 | 38.1 | 33.3 | 66 | 174 |
| Dixie King | 1869 | 738 | 267 | 39.5 | 34.0 | 55 | 140 |
| Deltapine SL | 1811 | 721 | 260 | 39.8 | 34.0 | 74 | 187 |
| Stoneville 7A | 1735 | 701 | 249 | 40.4 | 33.7 | 68 | 169 |
| Plains | 1771 | 678 | 243 | 38.3 | 33.7 | 64 | 167 |
| Fox 4 | 1739 | 663 | 238 | 38.1 | 33.3 | 67 | 176 |
| All-In-One | 1757 | 659 | 237 | 37.5 | 33.7 | 57 | 151 |
| Deltapine 15 | 1597 | 639 | 227 | 40.0 | 33.3 | 72 | 180 |
| Delfos 9169 | 1713 | 627 | 231 | 36.6 | 35.0 | 59 | 161 |
| LSD 5% | 231 | 90.3 | | | | | |
| CV 11.1% | | | | | | | |

Soil: Bude silt loam. Planted: May 14. Fertilizer: 300 lbs. 10-20-20 preplant plus 50 lbs. N side dressing. Poisoned: 8 times.

### Cotton Variety Averages, Ridge Soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc

| | Yield per acre, pounds lint | | | | | | Averages | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variety | 1957 | 1958 | 1959 | 1960 | 1961 | Ave. | Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
| Dixie King | 615 | 707 | 892 | 549 | 959 | 744 | 254 | 38.7 | 34.3 | 140 |
| Auburn 56 | 550 | 717 | 878 | 566 | 1010 | 744 | 254 | 37.5 | 34.1 | 173 |
| Stoneville 3202 | 551 | 737 | 798 | 603 | 986 | 735 | 247 | 39.8 | 33.3 | 175 |
| Plains | 531 | 749 | 743 | 542 | 922 | 698 | 248 | 38.0 | 34.3 | 163 |
| Deltapine SL | 474 | 737 | 746 | 569 | 928 | 691 | 238 | 40.6 | 34.3 | 179 |
| Empire | 543 | 657 | 707 | 530 | 817 | 651 | 232 | 38.2 | 34.3 | 140 |
| Deltapine 15 | 482 | 607 | 644 | 557 | 935 | 645 | 221 | 40.4 | 33.6 | 176 |
| Delfos 9169 | 435 | 581 | 738 | 449 | 742 | 589 | 206 | 37.3 | 34.9 | 166 |
| Rex | —— | 763 | 931 | 645 | 969 | | | | | |
| Stoneville 7 | 486 | 676 | 662 | 593 | | | | | | |
| Coker 100A | —— | —— | 946 | 534 | 1066 | | | | | |
| Fox 4 | —— | —— | 751 | 547 | 1050 | | | | | |
| DeKalb 108 | —— | —— | —— | 530 | 1014 | | | | | |
| All-In-One | —— | —— | —— | 508 | 860 | | | | | |

**Cotton Varieties, Ridge Soil, Pontotoc Ridge-Flatwoods Branch Station Pontotoc, 1961**

| | Yield per a., lbs | | Dollar | | Staple | Bolls per lb. | |
|---|---|---|---|---|---|---|---|
| Variety | Seed cotton | Lint | val. per a. SLM | Lint % | 32nds. inch | Seed cotton | Lint |
| Coker 100A | 2574 | 1066 | 382 | 41.4 | 34.0 | 63 | 152 |
| Fox 4 | 2672 | 1050 | 374 | 39.3 | 33.7 | 64 | 162 |
| DeKalb 108 | 2574 | 1014 | 367 | 39.4 | 34.0 | 54 | 137 |
| Auburn 56 | 2563 | 1010 | 360 | 39.4 | 33.7 | 60 | 152 |
| Stoneville 7A | 2421 | 1007 | 361 | 41.6 | 34.7 | 65 | 155 |
| DeKalb 220 | 2479 | 994 | 358 | 40.1 | 34.3 | 59 | 146 |
| Stoneville 3202 | 2399 | 986 | 342 | 41.1 | 32.7 | 66 | 161 |
| Rex | 2410 | 969 | 349 | 40.2 | 34.3 | 59 | 146 |
| Delta Queen | 2439 | 968 | 350 | 39.7 | 34.7 | 61 | 153 |
| Dixie King | 2363 | 959 | 345 | 40.6 | 34.0 | 51 | 126 |
| Deltapine 15 | 2232 | 935 | 330 | 41.9 | 33.3 | 69 | 165 |
| Deltapine SL | 2280 | 928 | 334 | 40.7 | 34.7 | 73 | 180 |
| Plains | 2352 | 922 | 334 | 39.2 | 34.3 | 58 | 148 |
| All-In-One | 2228 | 860 | 308 | 38.6 | 33.7 | 55 | 141 |
| Empire | 2084 | 817 | 296 | 39.2 | 34.3 | 52 | 132 |
| Delfos 9169 | 1957 | 742 | 270 | 37.9 | 34.0 | 59 | 156 |
| LSD 5% | 248 | 99 | | | | | |
| CV 9.2% | | | | | | | |

Soil: Atwood silty clay loam. Fertilizer: 80-60-60.
Planted: April 25. Poisoned: 10 times.

## Holly Springs

**Cotton Variety Averages, Hill Land, North Miss. Branch Station, Holly Springs.**

| | Yield pre acre, pounds lint | | | | | | Averages | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variety | 1957 | 1958 | 1959 | 1960 | 1961 | Ave. | Dollar val. per a., SLM | Lint % | Staple 32nds. inch | Bolls per lb. lint |
| Auburn 56 | 707 | 828 | 853 | 779 | 867 | 807 | 286 | 37.8 | 33.9 | 187 |
| Stoneville 3202 | 709 | 897 | 858 | 711 | 827 | 800 | 272 | 39.9 | 32.5 | 199 |
| Deltapine SL | 715 | 849 | 771 | 713 | 858 | 781 | 272 | 40.8 | 33.9 | 191 |
| Dixie King | 738 | 761 | 779 | 811 | 771 | 772 | 272 | 38.6 | 33.9 | 155 |
| Plains | 680 | 811 | 781 | 742 | 786 | 760 | 267 | 38.5 | 33.7 | 178 |
| Delfos 9169 | 701 | 743 | 706 | 747 | 786 | 737 | 264 | 37.4 | 34.8 | 180 |
| Deltapine 15 | 632 | 831 | 717 | 685 | 655 | 704 | 245 | 40.3 | 33.9 | 192 |
| Empire | 720 | 727 | 699 | 668 | 674 | 298 | 248 | 38.2 | 34.0 | 158 |
| Stoneville 7 | 694 | 948 | 831 | 773 | —— | | | | | |
| Pope | 744 | 892 | 892 | 731 | —— | | | | | |
| Stardel | 758 | 856 | 711 | 610 | —— | | | | | |
| Rex | —— | 657 | 756 | 742 | 764 | | | | | |
| Coker 100A | —— | —— | 784 | 755 | 811 | | | | | |
| Fox 4 | —— | —— | 831 | 694 | 743 | | | | | |
| DeKalb 108 | —— | —— | —— | 803 | 805 | | | | | |
| All-In-One | —— | —— | —— | 706 | 723 | | | | | |

**Cotton Varieties, Hill Land, North Miss. Branch Station, Holly Springs, 1961.**

| | Yield per a., lbs. | | Dollar | | Staple | Bolls per lb. | | % |
|---|---|---|---|---|---|---|---|---|
| Variety | Seed cotton | Lint | val. per a., SLM | Lint % | 32nds. inch | Seed cotton | Lint | first picking |
| Auburn 56 | 2205 | 867 | 309 | 39.3 | 33.7 | 67 | 171 | 79 |
| Deltapine SL | 2072 | 858 | 303 | 41.4 | 33.7 | 77 | 186 | 71 |
| Delta Queen | 2058 | 831 | 295 | 40.4 | 33.7 | 68 | 169 | 73 |
| Stoneville 3202 | 2037 | 827 | 287 | 40.6 | 32.0 | 74 | 183 | 79 |
| Stoneville 7A | 2023 | 827 | 293 | 40.9 | 33.3 | 71 | 174 | 73 |
| DeKalb 220 | 2037 | 813 | 289 | 39.9 | 33.7 | 65 | 164 | 77 |
| Coker 100A | 1988 | 811 | 292 | 40.8 | 34.0 | 70 | 172 | 72 |
| DeKalb 108 | 2037 | 805 | 287 | 39.5 | 33.7 | 62 | 158 | 78 |
| Delfos 9169 | 2074 | 786 | 286 | 37.9 | 34.0 | 64 | 169 | 72 |
| Plains | 1990 | 786 | 280 | 39.5 | 33.3 | 63 | 161 | 72 |
| Dixie King | 1937 | 771 | 274 | 39.8 | 33.3 | 57 | 144 | 75 |
| Rex | 1909 | 764 | 271 | 40.0 | 33.3 | 64 | 159 | 80 |
| Fox 4 | 1890 | 743 | 265 | 39.3 | 33.7 | 68 | 172 | 75 |
| All-In-One | 1874 | 723 | 259 | 38.6 | 33.3 | 65 | 167 | 74 |
| Empire | 1734 | 674 | 241 | 38.9 | 33.3 | 57 | 148 | 81 |
| Deltapine 15 | 1626 | 655 | 232 | 40.3 | 33.7 | 79 | 196 | 69 |
| LSD 5% | 196 | 78 | | | | | | |
| CV 10.3% | | | | | | | | |

Soil: Grenada silt loam. Fertilizer:72-48-48 Planted: May 3. Poisoned: 18 times.

**Cotton Varieties, Bottom Land, North Miss. Branch Station, Holly Springs, 1961.**

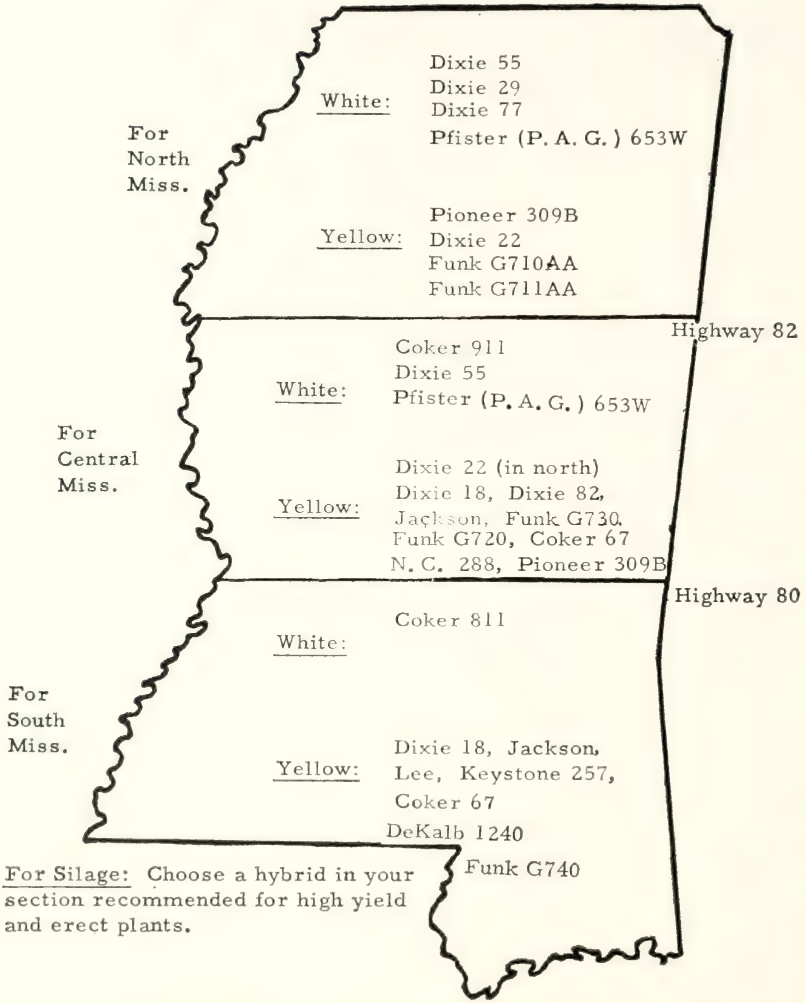
| | Yield per a., lbs. | | Dollar | | Staple | Bolls per lb. | | % |
|---|---|---|---|---|---|---|---|---|
| Variety | Seed cotton | Lint | val. per a., SLM | Lint % | 32nds. inch | Seed cotton | Lint | first picking |
| Stoneville 3202 | 3066 | 1153 | 421 | 37.6 | 34.0 | 60 | 160 | 57 |
| Coker 100A | 3071 | 1124 | 415 | 36.6 | 35.7 | 61 | 167 | 40 |
| DeKalb 108 | 3144 | 1116 | 414 | 35.5 | 35.7 | 52 | 146 | 47 |
| Auburn 56 | 3015 | 1113 | 410 | 36.9 | 35.3 | 61 | 166 | 47 |
| DeKalb 220 | 3071 | 1102 | 441 | 35.9 | 36.3 | 55 | 153 | 47 |
| Delta Queen | 2892 | 1044 | 389 | 36.1 | 36.3 | 62 | 172 | 42 |
| Delfos 9169 | 2970 | 1010 | 381 | 34.0 | 36.7 | 56 | 164 | 47 |
| Empire | 2873 | 985 | 371 | 34.3 | 36.3 | 50 | 146 | 55 |
| Fox 4 | 2800 | 983 | 366 | 35.1 | 35.7 | 63 | 181 | 44 |
| Dixie King | 2777 | 983 | 368 | 35.4 | 36.3 | 50 | 141 | 44 |
| Deltapine SL | 2600 | 970 | 359 | 37.3 | 36.0 | 69 | 184 | 44 |
| Plains | 2718 | 962 | 357 | 35.4 | 35.0 | 57 | 161 | 43 |
| Stoneville 7A | 2607 | 954 | 352 | 36.6 | 35.7 | 63 | 172 | 40 |
| Rex | 2449 | 864 | 323 | 35.3 | 36.7 | 55 | 155 | 47 |
| Deltapine 15 | 2213 | 828 | 304 | 37.4 | 35.3 | 63 | 169 | 43 |
| All-In-One | 2529 | 852 | 319 | 33.7 | 35.7 | 51 | 152 | 39 |
| LSD at 5% | 356 | 128 | | | | | | |
| CV 12.5% | | | | | | | | |

Soil: Collins. Fertilizer: 72-48-48. Planted over: May 17. Poisoned: 12 times.

BULLETIN 638 JANUARY 1962

# Hybrid Corn Tests, Mississippi 1961

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI


For North Miss.
White:
Dixie 55
Dixie 29
Dixie 77
Pfister (P. A. G.) 653W
Yellow:
Pioneer 309B
Dixie 22
Funk G710AA
Funk G711AA
Highway 82
For Central Miss.
White:
Coker 911
Dixie 55
Pfister (P. A. G.) 653W
Yellow:
Dixie 22 (in north)
Dixie 18, Dixie 82,
Jackson, Funk G730,
Funk G720, Coker 67
N. C. 288, Pioneer 309B
Highway 80
For South Miss.
White:
Coker 811
Yellow:
Dixie 18, Jackson,
Lee, Keystone 257,
Coker 67
DeKalb 1240
Funk G740
For Silage: Choose a hybrid in your section recommended for high yield and erect plants.

Hybrids recommended for various areas of the State.

# 1961 HYBRID CORN TESTS

By C. M. GROGAN And C. M. CAMPBELL[1]

Favorable growing conditions for corn were general throughout Mississippi during 1961. Record yields were obtained in the tests and on farms. The average yield for the state was 37 bushels per acre but was more than 90 bushels in the main hybrid tests. This fact would indicate that we are not approaching the full potential for yield, although we must consider many acres of corn are planted on marginal land.

The weather conditions were suitable for planting for a number of tests, but excessive moisture delayed plantings in other areas. However, the favorable conditions thereafter contributed toward an excellent harvest. Little weather interference was experienced at harvest. A total of 15 tests were planted and harvested. Seven of these were located in the northern part of the state, (roughly north of Highway 82), six in central Mississippi which is the area between Highway 80 and 82, and two tests in the southern part of the state. Both the northern and central groups of hybrids were grown at State College and at Stoneville, resulting in two tests at these locations.

All tests were check planted with each hybrid in each replication planted in a plot two hills by five hills. The check system of planting was used to facilitate note taking and computations. An effort was made to get the desired number of plants per hill by planting at a rate higher than desired and later thinning to a stand suitable for corn production for the area.

Information on insects was collected by W. A. Douglas, C. A. Henderson, and R. A. Blanchard, U.S.D.A. Entomologists working on corn insects. Depending on the location of the tests, notes were taken on the extent of earworm damage, percent of ears infested with the pink corn worm and rice weevil, and the extension of the husk and size of the silk channel. Generally, a hybrid with a long husk with a constricted silk channel has more resistance to insect attacks to the ear than one not possessing these characteristics. The nature of resistance is largely mechanical, although a type of physiological resistance is apparent in some strains of corn.

Lodging is an important factor in most areas of the state. Stalk lodging was excessive in the majority of tests in northern Mississippi and at Yazoo City. Much of the lodging was attributed to the heavy infestation of the Southwestern stalk borer. This pest is becoming increasingly dangerous and threatens corn production in the northern areas of Mississippi. The rate at which it is spreading is of concern to farmers and research workers throughout the state. Research is being planned to determine the best approach in limiting damage.

The number of ears per plant is commanding more attention since efficiency has become an essential part of economic survival on American farms. The southern open-pollinated varieties and their hybrid derivatives are generally prolific to varying degrees. The prolific characteristic is especially useful in an area with variable environmental conditions. When the conditions are favorable for production, the prolific hybrids produce

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[1] Agronomists, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture in cooperation with the Mississippi Agricultural Experiment Station and the Entomology Division, Agricultural Research Service, U. S. Department of Agriculture. The tests were conducted jointly with agronomists at the branch experiment stations and Mr. M. A. Luter, farmer, Tylertown.

**Table 1.—Average yields, in bushels per acre, of 25 hybrids in seven 1961 North Mississippi tests.**

| Hybrid | Average 7 tests | Holly Springs | Verona | State College | Pontotoc (Ridge) | Pontotoc (Flat-woods) | Clarks-dale | Stone-ville |
|---|---|---|---|---|---|---|---|---|
| Delta 9907 | 113.2 | 98.1 | 135.7 | 91.5 | 86.2 | 105.5 | 121.3 | 153.8 |
| Miss 6133 | 107.2 | 86.3 | 116.1 | 87.3 | 90.0 | 92.4 | 123.8 | 154.6 |
| Dixie 55 | 107.0 | 101.7 | 121.9 | 88.8 | 80.4 | 97.3 | 120.1 | 138.8 |
| Riemer 305 | 106.2 | 103.8 | 122.2 | 86.7 | 83.3 | 89.9 | 110.4 | 147.2 |
| Miss 6131 | 104.4 | 99.6 | 122.5 | 86.8 | 78.3 | 103.0 | 104.9 | 136.0 |
| Delta 8812 | 104.0 | 94.7 | 113.1 | 88.4 | 83.9 | 92.2 | 115.8 | 139.6 |
| Miss 6135 | 104.0 | 95.7 | 117.8 | 88.4 | 84.9 | 97.9 | 115.9 | 127.2 |
| P.A.G. 653W | 101.9 | 89.1 | 118.6 | 85.6 | 89.1 | 100.9 | 108.2 | 121.7 |
| Dixie 22 | 101.0 | 93.5 | 114.9 | 88.5 | 76.2 | 93.5 | 109.9 | 130.6 |
| Dixie 77 | 98.4 | 87.1 | 106.7 | 90.0 | 75.4 | 96.6 | 100.0 | 132.3 |
| Pioneer 309B | 98.0 | 92.6 | 108.7 | 79.7 | 80.3 | 87.2 | 113.5 | 123.7 |
| Funk G710AA | 95.6 | 78.6 | 118.1 | 82.5 | 82.3 | 84.0 | 103.7 | 120.1 |
| Mid South | 95.1 | 78.9 | 117.7 | 82.7 | 72.7 | 86.9 | 109.1 | 117.4 |
| Funk G711AA | 94.0 | 88.0 | 114.9 | 80.1 | 80.0 | 85.3 | 97.6 | 112.3 |
| Keystone 256 | 94.0 | 80.1 | 101.5 | 79.8 | 77.0 | 80.6 | 115.5 | 123.6 |
| Tenn. 501 | 93.8 | 79.7 | 114.3 | 78.9 | 75.8 | 82.9 | 106.3 | 118.8 |
| Dixie 29 | 93.3 | 70.9 | 102.4 | 83.3 | 76.3 | 78.1 | 107.7 | 134.7 |
| P.A.G. 488 | 91.3 | 84.4 | 106.7 | 72.2 | 80.3 | 84.6 | 101.8 | 109.1 |
| Coker 616 | 90.7 | 81.3 | 109.7 | 78.7 | 66.7 | 85.5 | 101.1 | 111.7 |
| Pioneer 309A | 90.1 | 82.2 | 102.5 | 75.0 | 76.3 | 83.7 | 96.9 | 113.9 |
| P.A.G. 480 | 89.1 | 82.8 | 103.9 | 75.4 | 73.1 | 84.4 | 97.4 | 106.9 |
| Stull 400W | 87.3 | 72.4 | 105.5 | 78.4 | 78.4 | 77.7 | 88.4 | 110.3 |
| Funk G702 | 87.2 | 65.8 | 104.9 | 77.5 | 76.6 | 74.9 | 96.9 | 113.7 |
| McCurdy 999 | 86.9 | 75.4 | 93.3 | 75.6 | 71.3 | 87.6 | 97.2 | 107.8 |
| DeKalb 633 | 78.6 | 62.6 | 91.9 | 69.4 | 74.8 | 69.6 | 91.2 | 90.7 |
| Average | 95.8 | 85.3 | 111.7 | 82.1 | 78.5 | 88.1 | 106.2 | 118.8 |
| L.S.D., 5% |  | 3.3 | 10.8 | 6.5 | 8.5 | 10.8 | 12.2 | 10.8 |
| C.V. (%) |  | 3.4 | 8.4 | 6.9 | 16.0 | 10.7 | 9.0 | 8.0 |

more than one ear per plant, but when conditions are unfavorable, there is an adjustment by the plant to the situation. The abiliy of a plant to make an adjusment is imporant also in endeavoring to obtain record yields since fewer plants per unit of land area are required of prolifics than single-ear hybrids. Shading effect, found to be a detrimental factor in high plant densities, is reduced when prolific hybrids are used. A look at the results of tests will reveal that the prolific hybrids form the highest-yielding group, and the non-prolific hybrids the lowest.

Yields in individual tests were exceptional in 1961. Among hybrids individual yields ranged from 154.6 bushels per acre at Stoneville to a low of 41.2 at Poplarville. However, the hybrid producing 41.2 bushels had an extremely poor stand. Ordinarily, Keystone 257 has a good yield but apparently the lot sent for testing purposes did not produce a sufficient number of plants to maintain the yield record of the past few years. Stoneville, Verona, and Clarksdale had the highest individual yield records for the northern region. Stoneville and Yazoo City were the highest in the central region. Highest yield in tests, including experimental hybrids and tests for special purposes, was 196.1 bushels per acre.

A farmer should take into consideration the three-year average when purchasing a hybrid. A good three-year average figure will give a much better picture of what might be expected of the performance of a hybrid. Too often we fail to take other agronomic attributes into consideration by being too absorbed in yield comparisons. These other factors may be very important in many ways, and may, under certain circumstances, be more important than yield itself. Also, depending

**Table 3. Average yields, in bushels per acre, of 25 hybrids in six 1961 Central Mississippi tests.**

| Hybrid | Average 6 tests | State College | Brooksville | Newton | Raymond | Stoneville | Yazoo City |
|---|---|---|---|---|---|---|---|
| Miss 0002 (EXP.) | 104.4 | 96.1 | 94.7 | 64.2 | 106.1 | 141.0 | 124.1 |
| Dixie 82 | 102.8 | 88.9 | 93.3 | 76.4 | 105.0 | 123.1 | 130.3 |
| Dixie 55 | 101.0 | 86.4 | 87.2 | 77.3 | 109.8 | 130.5 | 114.8 |
| Funk G795W | 100.8 | 88.7 | 97.5 | 77.6 | 96.6 | 148.4 | 96.0 |
| Riemer 308 | 100.1 | 87.4 | 94.0 | 69.2 | 106.3 | 129.1 | 114.9 |
| KC 288 | 98.0 | 85.1 | 81.9 | 70.7 | 100.8 | 121.0 | 128.6 |
| Jackson | 93.4 | 78.7 | 82.2 | 67.2 | 94.0 | 115.9 | 122.7 |
| DeKalb 1225 | 93.3 | 76.0 | 86.2 | 77.1 | 99.3 | 116.6 | 104.8 |
| P.A.G. 653W | 92.5 | 88.7 | 84.5 | 82.4 | 85.8 | 120.3 | 93.3 |
| Dixie 18 | 91.8 | 74.8 | 80.8 | 67.6 | 94.6 | 121.7 | 111.1 |
| DeKalb 1240 | 90.3 | 80.0 | 82.6 | 58.7 | 93.5 | 123.9 | 103.4 |
| Coker 67 | 90.1 | 77.9 | 80.3 | 62.1 | 95.0 | 122.9 | 102.4 |
| Funk G720 | 90.1 | 79.3 | 88.4 | 62.1 | 85.8 | 117.6 | 107.4 |
| Funk G730 | 89.7 | 79.3 | 88.6 | 76.0 | 86.0 | 110.3 | 98.2 |
| Dixie 22 | 89.2 | 80.4 | 90.7 | 65.5 | 85.9 | 119.7 | 93.1 |
| P.A.G. 750 | 88.4 | 79.3 | 70.9 | 54.6 | 91.1 | 127.3 | 107.1 |
| DeKalb 1201 | 88.4 | 73.2 | 76.5 | 74.9 | 88.2 | 122.3 | 95.1 |
| Riemer 302 | 88.3 | 81.6 | 87.8 | 62.2 | 85.2 | 118.9 | 93.9 |
| Coker 911 | 88.1 | 78.0 | 81.8 | 63.9 | 92.8 | 120.8 | 91.6 |
| McCurdy 1003C | 86.7 | 77.3 | 81.7 | 67.6 | 81.7 | 118.2 | 93.7 |
| Pioneer 309B | 85.4 | 78.9 | 82.7 | 74.4 | 78.6 | 114.0 | 83.6 |
| Lee | 84.3 | 72.6 | 72.5 | 60.4 | 85.4 | 115.6 | 99.1 |
| Coker 71 | 83.7 | 78.2 | 69.3 | 70.1 | 92.4 | 108.2 | 83.8 |
| Keystone 257 | 77.2 | 65.7 | 67.6 | 50.3 | 74.8 | 108.8 | 95.8 |
| P.A.G. 488 | 77.2 | 70.6 | 73.3 | 68.3 | 79.4 | 99.1 | 72.8 |
| Average | 90.2 | 80.2 | 83.1 | 68.1 | 91.8 | 115.8 | 102.4 |
| L.S.D, 5% | | 5.2 | 7.4 | 4.8 | 9.1 | 11.5 | 13.0 |
| C. V. (%) | | 5.6 | 7.8 | 6.1 | 8.6 | 8.7 | 11.0 |

on the need, some of the early hybrids not on the list of hybrids of above-average performances may be found very useful for early harvesting or hogging.

Findings in other tests reveal that corn can be planted much earlier than is generally practiced in Mississippi. This means that corn can be planted before cotton and harvested before cotton picking.

Table 2.—Average data of seven North Mississippi main hybrid tests, 1961.

| | Yield, Bu./A | | Lodging | | Ear | Ears | Moist | | Earworm* | | P.C.W.[2]* | Husk* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hybrid | 3-Year Average | 1961 | Root % | Stalk % | ht. ft. | per plant no. | in grain % | Stand % | Pene-[1] tration in. | Ears in- fested % | ears in- fested % | Exten-[3] sion in. | Tight-[4] ness in. |
| Delta 9907 (Exp.) | —— | 113.2 | 1 | 15 | 4.6 | 1.7 | 14.7 | 99 | 1.1 | 72 | 100 | 2.5 | 0.74 |
| Miss. 6133 (Exp.) | 87.2 | 107.2 | 1 | 24 | 4.5 | 1.7 | 13.7 | 94 | 1.0 | 79 | 100 | 3.1 | 0.65 |
| Dixie 55 | 85.8 | 107.0 | 0 | 23 | 4.7 | 1.5 | 14.8 | 97 | 1.1 | 78 | 100 | 3.3 | 0.65 |
| Riemer 305 | —— | 106.2 | 0 | 22 | 4.7 | 1.6 | 14.2 | 96 | 1.1 | 80 | 100 | 3.2 | 0.68 |
| Miss. 6131 (Exp.) | 87.5 | 104.4 | 1 | 21 | 4.6 | 1.6 | 13.6 | 94 | 1.0 | 76 | 100 | 3.1 | 0.69 |
| Delta 8812 (Exp.) | —— | 104.0 | 1 | 17 | 4.4 | 1.4 | 14.3 | 98 | 1.1 | 77 | 100 | 3.1 | 0.67 |
| Miss. 6135 (Exp.) | —— | 104.0 | 0 | 18 | 4.7 | 1.8 | 14.0 | 96 | 1.0 | 75 | 100 | 2.8 | 0.71 |
| P.A.G. 653W | 80.0 | 101.9 | 0 | 18 | 4.0 | 1.5 | 14.2 | 96 | 0.8 | 71 | 100 | 2.8 | 0.70 |
| Dixie 22 | 81.6 | 101.0 | 1 | 18 | 4.7 | 1.3 | 14.3 | 96 | 1.0 | 73 | 100 | 2.6 | 0.80 |
| Dixie 77 | 82.4 | 98.4 | 1 | 23 | 4.2 | 1.5 | 14.5 | 97 | 1.2 | 88 | 100 | 2.3 | 0.81 |
| Pioneer 309B | 79.6 | 98.0 | 1 | 14 | 3.9 | 1.2 | 14.3 | 99 | 1.0 | 76 | 100 | 2.2 | 0.80 |
| Funk G710AA | 79.5 | 95.6 | 0 | 16 | 4.3 | 1.3 | 14.7 | 95 | 1.2 | 87 | 100 | 2.3 | 0.86 |
| Mid South | 75.4 | 95.1 | 0 | 16 | 4.7 | 1.2 | 13.9 | 96 | 1.3 | 87 | 100 | 2.1 | 0.84 |
| Funk G711AA | 79.1 | 94.0 | 0 | 19 | 4.2 | 1.1 | 14.8 | 96 | 1.2 | 82 | 100 | 1.9 | 0.91 |
| Keystone 256 | 75.5 | 94.0 | 0 | 15 | 4.8 | 1.3 | 14.1 | 98 | 1.1 | 73 | 100 | 3.1 | 0.65 |
| Tenn. 501 | 76.0 | 93.8 | 0 | 21 | 3.8 | 1.3 | 14.0 | 97 | 1.4 | 86 | 100 | 2.0 | 0.95 |
| Dixie 29 | 77.6 | 93.3 | 1 | 17 | 4.1 | 1.4 | 14.4 | 91 | 1.2 | 84 | 100 | 3.0 | 0.70 |
| P.A.G. 488 | 75.2 | 91.3 | 1 | 21 | 4.2 | 1.3 | 15.2 | 97 | 1.1 | 84 | 100 | 2.0 | 0.90 |
| Coker 616 | —— | 90.7 | 1 | 15 | 3.9 | 1.2 | 14.2 | 96 | 1.2 | 92 | 100 | 2.2 | 0.81 |
| Pioneer 309A | 74.9 | 90.1 | 0 | 11 | 3.9 | 1.0 | 13.8 | 98 | 1.3 | 83 | 100 | 2.5 | 0.83 |
| P.A.G. 480 | —— | 89.1 | 1 | 20 | 4.0 | 1.2 | 14.1 | 96 | 1.2 | 87 | 100 | 1.7 | 0.90 |
| Stull 400W | —— | 87.3 | 0 | 21 | 3.9 | 1.0 | 13.1 | 97 | 1.4 | 89 | 100 | 2.1 | 0.95 |
| Funk G702 | —— | 87.2 | 0 | 13 | 3.7 | 1.1 | 13.8 | 98 | 1.4 | 85 | 100 | 2.2 | 0.93 |
| McCurdy 999 | 73.6 | 86.9 | 0 | 19 | 4.0 | 1.1 | 13.3 | 97 | 1.3 | 79 | 100 | 2.5 | 0.82 |
| DeKalb 633 | —— | 78.6 | 0 | 13 | 3.4 | 1.0 | 13.1 | 95 | 1.7 | 91 | 100 | 2.3 | 0.96 |
| Averages | —— | 95.8 | 0 | 18 | 4.2 | 1.3 | 14.1 | 96 | 1.2 | 81 | 100 | 2.5 | 0.80 |

[1]Inches from tip of ear. [2]Pink corn worm. [3]Inches beyond tip of ear. [4]Diameter of silk channel at tip of ear.

*Average of two locations: Holly Springs and State College.

Exp. — Experimental hybrids not commercially available.

**Table 4.—Average data of six central Mississippi main hybrid tests, 1961**

| Hybrid | Yield, Bu./A. |  | Lodging |  | Ear | Ears per | Moist in |  | Earworm |  | P.C.W.[2] | R.W.[5] | Husk |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | 3 year Average | 1961 | Root % | Stalk % | ht. ft. | plant no. | grain % | Stand % | Pene.[1] tration in. | Ears in. fested % | ears in- fested % | ears infes. %* | Exten-[3] sion in. | Tight-[4] ness in. |
| Miss. 0002 (Exp.) | —— | 104.4 | 0 | 20 | 4.5 | 1.8 | 13.7 | 93 | 0.8 | 62 | 100 | 10 | 3.5 | 0.67 |
| Dixie 82 | 89.8 | 102.8 | 0 | 15 | 4.7 | 1.6 | 14.4 | 98 | 0.7 | 60 | 100 | 8 | 2.9 | 0.69 |
| Dixie 55 | 90.6 | 101.0 | 0 | 18 | 4.3 | 1.7 | 13.5 | 95 | 0.8 | 67 | 100 | 13 | 3.2 | 0.68 |
| Funk G795W | —— | 100.8 | 0 | 20 | 3.8 | 1.6 | 13.8 | 96 | 1.0 | 75 | 100 | 13 | 2.6 | 0.75 |
| Riemer 308 | —— | 100.1 | 0 | 14 | 4.9 | 1.6 | 14.4 | 94 | 0.7 | 58 | 100 | 5 | 3.1 | 0.67 |
| NC 288 | 84.9 | 98.0 | 0 | 14 | 4.6 | 1.4 | 14.5 | 97 | 0.9 | 69 | 100 | 8 | 2.7 | 0.74 |
| Jackson | 76.7 | 93.4 | 0 | 10 | 5.1 | 1.5 | 14.3 | 96 | 0.8 | 61 | 100 | 5 | 2.9 | 0.70 |
| DeKalb 1225 | —— | 93.3 | 2 | 13 | 5.0 | 1.5 | 13.5 | 96 | 0.7 | 59 | 100 | 3 | 2.7 | 0.70 |
| P.A.G. 653W | 83.6 | 92.5 | 0 | 17 | 4.0 | 1.7 | 13.9 | 97 | 0.8 | 65 | 100 | 20 | 2.8 | 0.78 |
| Dixie 18 | 80.0 | 91.8 | 0 | 11 | 5.1 | 1.5 | 14.1 | 96 | 0.7 | 55 | 100 | 0 | 3.4 | 0.64 |
| DeKalb 1240 | —— | 90.3 | 1 | 19 | 4.8 | 1.7 | 14.1 | 96 | 0.7 | 55 | 100 | 10 | 2.6 | 0.70 |
| Coker 67 | 79.2 | 90.1 | 0 | 13 | 4.2 | 1.6 | 14.5 | 95 | 0.7 | 56 | 100 | 13 | 2.7 | 0.69 |
| Funk G720 | 84.4 | 90.1 | 0 | 11 | 4.2 | 1.2 | 13.9 | 96 | 0.9 | 68 | 100 | 10 | 2.3 | 0.86 |
| Funk G730 | 80.0 | 89.7 | 0 | 14 | 4.0 | 1.4 | 13.9 | 95 | 0.9 | 67 | 100 | 0 | 2.8 | 0.77 |
| Dixie 22 | 82.0 | 89.2 | 0 | 16 | 4.4 | 1.4 | 14.0 | 97 | 1.0 | 76 | 100 | 8 | 2.5 | 0.84 |
| P.A.G. 750 | —— | 88.4 | 0 | 12 | 4.3 | 1.6 | 14.1 | 97 | 0.7 | 58 | 100 | 5 | 2.6 | 0.72 |
| DeKalb 1201 | —— | 88.4 | 1 | 20 | 4.5 | 1.3 | 13.8 | 97 | 0.9 | 60 | 100 | 5 | 2.5 | 0.81 |
| Riemer 302 | —— | 88.3 | 0 | 21 | 4.4 | 1.3 | 13.8 | 95 | 0.9 | 72 | 100 | 18 | 2.4 | 0.81 |
| Coker 911 | 77.9 | 88.1 | 1 | 17 | 4.0 | 1.4 | 13.9 | 98 | 0.9 | 63 | 100 | 10 | 2.3 | 0.81 |
| McCurdy 1003C | 74.2 | 86.7 | 1 | 20 | 4.7 | 1.3 | 13.8 | 95 | 0.9 | 65 | 100 | 10 | 3.0 | 0.71 |
| Pioneer 309B | 79.2 | 85.4 | 0 | 12 | 3.4 | 1.3 | 14.1 | 97 | 1.1 | 72 | 100 | 5 | 2.3 | 0.84 |
| Lee | 72.8 | 84.3 | 0 | 11 | 4.6 | 1.5 | 14.1 | 96 | 0.8 | 65 | 100 | 0 | 3.0 | 0.64 |
| Coker 71 | 75.5 | 83.7 | 1 | 10 | 4.2 | 1.5 | 14.7 | 94 | 0.8 | 55 | 100 | 0 | 2.6 | 0.70 |
| Keystone 257 | 75.0 | 77.2 | 0 | 9 | 4.8 | 1.4 | 14.6 | 72 | 0.8 | 59 | 100 | 5 | 3.0 | 0.67 |
| P.A.G. 488 | 72.9 | 77.2 | 0 | 19 | 3.9 | 1.3 | 13.9 | 96 | 1.1 | 77 | 100 | 25 | 1.8 | 0.94 |
| Average | —— | 90.2 | 0 | 15 | 4.3 | 1.5 | 14.1 | 95 | 0.8 | 64 | 100 | 8 | 2.7 | 0.74 |

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. [5] Rice Weevil.

*One test only: Raymond, Mississippi.

Exp. — Experimental hybrid not commercially available.

Table 5.—Average data of two South Mississippi main hybrid tests, 1961.

| | Yield, Bushels/Acre | | | | Lodging | | Ear | Ears per | Moist. | | Earworm | | P.C.W.[2] | R.W.[5] | Husk | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hybrid | 3 year Average | Poplar-ville | Tyler-town | 1961 | Root % | Stalk % | ht. ft. | plant no. | in grain % | Stand % | Pene-[1] tration in. | Ears in-fested % | ears in-fested % | ears infes. % | Exten-[3] sion in. | Tight-[4] ness in |
| Miss. 8484 (Exp.) | —— | 82.0 | 126.8 | 104.4 | 0 | 1 | 5.5 | 1.5 | 16.7 | 97 | 0.6 | 38 | 90 | 20 | 3.8 | 0.61 |
| Riemers 308 | —— | 84.4 | 117.2 | 100.8 | 0 | 7 | 5.3 | 1.6 | 15.7 | 92 | 0.6 | 52 | 100 | 20 | 3.1 | 0.76 |
| Funk G795W | —— | 77.0 | 121.5 | 99.3 | 1 | 8 | 4.0 | 1.8 | 17.1 | 96 | 0.7 | 54 | 100 | 52 | 2.7 | 0.74 |
| Coker 67 | 64.2 | 80.2 | 117.4 | 98.8 | 1 | 3 | 4.7 | 1.7 | 15.7 | 97 | 0.6 | 46 | 100 | 38 | 2.4 | 0.78 |
| Jackson | 61.4 | 75.9 | 120.1 | 98.0 | 0 | 2 | 5.3 | 1.5 | 15.6 | 94 | 0.7 | 52 | 92 | 28 | 3.1 | 0.71 |
| Miss. 8288 | —— | 80.2 | 113.7 | 97.0 | 2 | 1 | 5.2 | 1.5 | 17.1 | 90 | 0.6 | 44 | 98 | 32 | 3.4 | 0.71 |
| Coker 811 | 60.2 | 73.8 | 119.0 | 96.4 | 0 | 2 | 4.6 | 1.7 | 16.6 | 96 | 0.8 | 68 | 100 | 6 | 2.3 | 0.78 |
| Dixie 55 | —— | 74.8 | 113.6 | 94.2 | 5 | 4 | 4.9 | 1.6 | 17.3 | 91 | 0.8 | 60 | 98 | 36 | 2.7 | 0.74 |
| Miss 6002 (Exp.) | 63.7 | 79.4 | 106.3 | 92.9 | 2 | 3 | 5.1 | 1.3 | 15.4 | 97 | 0.7 | 54 | 90 | 12 | 3.6 | 0.67 |
| DeKalb 1240 | 57.3 | 72.7 | 110.5 | 91.6 | 0 | 2 | 5.2 | 1.8 | 16.2 | 95 | 0.4 | 32 | 98 | 26 | 2.8 | 0.68 |
| Dixie 18 | 57.0 | 74.3 | 104.9 | 89.6 | 1 | 1 | 5.5 | 1.5 | 18.2 | 96 | 0.5 | 46 | 98 | 26 | 3.2 | 0.67 |
| DeKalb 1225 | —— | 69.9 | 107.8 | 88.9 | 2 | 7 | 5.3 | 1.5 | 16.7 | 95 | 0.6 | 52 | 96 | 26 | 2.6 | 0.92 |
| Miss. 8440 (Exp.) | —— | 68.0 | 109.6 | 88.8 | 1 | 4 | 5.1 | 1.7 | 18.6 | 97 | 0.5 | 46 | 92 | 28 | 3.7 | 0.66 |
| Miss. 6004 (Exp.) | 59.5 | 76.5 | 100.2 | 88.4 | 0 | 4 | 5.1 | 1.4 | 17.6 | 98 | 0.5 | 46 | 94 | 22 | 3.8 | 0.70 |
| Miss. 8464 (Exp.) | 57.1 | 63.0 | 113.4 | 88.2 | 1 | 6 | 4.8 | 1.4 | 18.6 | 98 | 0.6 | 50 | 96 | 34 | 2.7 | 0.56 |
| Miss. 6115 (Exp.) | —— | 69.4 | 105.9 | 87.7 | 0 | 1 | 5.0 | 1.1 | 16.2 | 97 | 0.4 | 26 | 96 | 24 | 2.7 | 0.78 |
| Funk G740 | 58.8 | 64.2 | 110.5 | 87.4 | 1 | 5 | 5.1 | 1.3 | 18.2 | 99 | 0.7 | 58 | 96 | 24 | 2.2 | 0.72 |
| Miss. 8305 | —— | 66.3 | 107.6 | 87.0 | 0 | 2 | 5.5 | 1.8 | 17.1 | 93 | 0.6 | 44 | 94 | 16 | 3.4 | 0.67 |
| Funk G745 | —— | 64.3 | 108.9 | 86.6 | 0 | 4 | 4.6 | 1.4 | 19.8 | 98 | 0.9 | 64 | 98 | 36 | 1.5 | 0.91 |
| McCurdy 1003C | 54.8 | 66.8 | 104.0 | 85.4 | 1 | 4 | 5.0 | 1.3 | 17.8 | 94 | 0.8 | 54 | 100 | 46 | 2.4 | 0.87 |
| Miss. 6111 (Exp.) | —— | 65.2 | 102.8 | 84.0 | 0 | 1 | 5.4 | 1.1 | 18.6 | 96 | 0.5 | 40 | 92 | 18 | 2.9 | 0.70 |
| Pioneer 309B | —— | 67.1 | 98.6 | 82.9 | 1 | 8 | 3.9 | 1.3 | 18.2 | 96 | 1.0 | 74 | 100 | 52 | 2.1 | 0.85 |
| Lee | 55.6 | 67.4 | 93.8 | 80.6 | 0 | 2 | 4.9 | 1.5 | 16.0 | 93 | 0.4 | 40 | 92 | 20 | 3.1 | 0.66 |
| Coker 71 | 55.0 | 67.2 | 84.0 | 75.6 | 1 | 2 | 4.5 | 1.6 | 19.0 | 88 | 0.6 | 46 | 100 | 24 | 2.5 | 0.77 |
| Keystone 257 | 45.7 | 41.2 | 63.2 | 52.2 | 1 | 3 | 5.0 | 1.5 | 18.0 | 42 | 0.6 | 48 | 96 | 26 | 3.1 | 0.70 |
| Average | —— | 71.0 | 107.2 | 89.1 | 1 | 3 | 5.0 | 1.5 | 17.3 | 94 | 0.6 | 49 | 97 | 28 | 2.9 | 0.72 |
| LSD, 5% | —— | 7.0 | 3.8 | | | | | | | | | | | | | |
| CV % | | 8.6 | 3.1 | | | | | | | | | | | | | |

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. [5] Rice Weevil.

# Bell Pepper Production In Mississippi

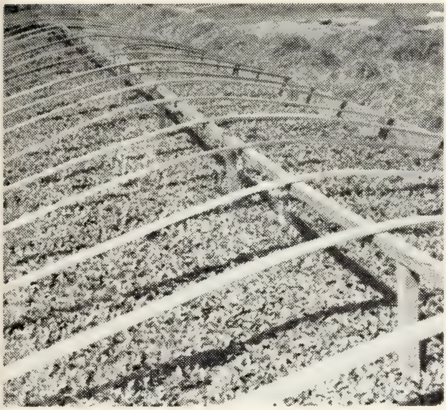

Fig. 1. Temporary bed for growing plants.

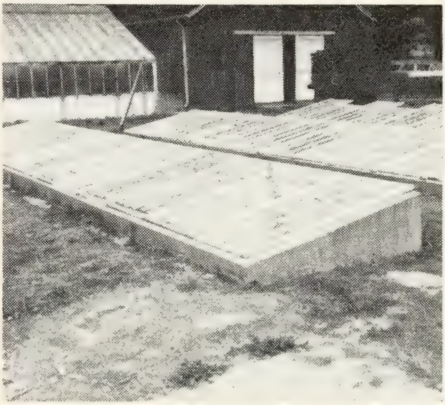

Fig. 2. Permanent type plant-growing structure.

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

# BELL PEPPER PRODUCTION IN MISSISSIPPI

By STEVE L. WINDHAM

Bell peppers have been grown in Mississippi for more than 50 years. The bulk of the crop is grown for the mature green fresh market, with smaller acreages for the pickling and the mature red industry. Practices reported in this publication are primarily for production of mature green fruit but most of them are also applicable to other types of production. This material is a summarization of results obtained at the Truck Crops Branch Experiment Station.

### Variety Selection

Keystone Resistant Giant is the recommended variety for upland soils similar to those at the Truck Crops Branch Sation. This is especially true when earliness is a factor and large, smooth fruit with thick walls are desired. On bottom soils where earliness is the major objective, Early Calwonder should be planted. In both locations if large total yields are more important than earliness, Yolo Wonder L or Yolo Wonder B should be used. Where production has been good during the first part of the season but declined from midseason on, it may be well to plant a combination of one of the early varieties and the later maturing varieties. This provides a more uniform yield throughout the season.

All varieties named produce fruit acceptable to the trade. The fruit wall of Early Calwonder is not as thick as for the other varieties. The fruit of Yolo Wonder B has a greater tendency to be tapered and misshapen when grown under conditions other than ideal. While this detracts from the appearance of the finished pack, the large total yields often offsets this disadvantage. Yolo Wonder L produces the largest fruit but is three to seven days later than varieties named.

Foliage of the Yolo Wonder strains and Keystone Resistant Giant is denser than that of Early Calwonder or California Wonder. This prevents sunscald, but is detrimental during an outbreak of bacterial spot. Keystone Resistant Giant and the Yolo Wonder strains have resistance to tobacco mosaic.

### Plant Production

Seed must be sown in a protective coldframe or hotbed for plants to obtain adequate size and be ready to transplant as soon as the chance of the last killing frost has passed.

The temporary bed in Figure 1 is least expensive and good plants can be produced with proper precautions. However, since it has no supplementary heat, seed must be sown about 12 weeks before transplanting time to insure adequate growth. The chance of damping-off is greater and low outside temperatures ( 15 to 20° F.) may severely damage plants. This type bed is covered with both a sheet of polyethylene and cloth until the seedlings emerge. The polyethylene is used on sunny days to trap heat and speed germination. When plants have emerged this sheet is removed and only the cloth cover is used. When below freezing temperatures are expected, the use of double cloths and/or supplementary covering such as pine or grass straw is necessary.

The permanent bed (Fig. 2) is more expensive but also more reliable. Heat is supplied by electric heating cable. The cover is 3 by 6 feet glass sash. Plants can be grown to transplanting size within 8 weeks as seed germinate earlier when minimum soil temperatures are maintained at 65 to 70° F. No additional protection is needed except during extremely low temperatures. To reduce initial cost, cloth covering may be substituted for the glass sash and the framework can be made of wood.

Regardless of type of structure used, new leaf mold and/or a sandy loam soil should be used. Soil should be treated with a temporary soil sterilant, such as Vapam, Mylone or Bedrench[1] to prevent weeds and disease problems. Directions on containers should be followed.

Seeds are sown at the rate of 4 ounces per acre to be set and can be sown either broadcast or in rows. The rate for broadcast is 6 ounces per 36 square feet, and 4 ounces when planted in rows spaced 3 inches apart. Either method is satisfactory. A larger number of plants are produced per square foot when seed are broadcast but the chances of loss from damping-off is less and generally sturdier plants are obtained when seed are planted in rows. Seed should be covered with ¼ to ½ inch of treated soil or new leaf mold, then sprinkled lightly until moisture is adequate. Additional water added during mid-morning on a sunny day, helps prevent wide fluctuation in soil temperatures. The beds can remain open until excessive moisture has dried. On warm days when little or no wind is present the cloth covering or sash is removed from the beds. Under less favorable conditions sash are cracked alternately at top or bottom or the ends of the cloth are propped open. On cool windy days ventilation is away from the wind.

### Soil Selection and Preparation

The first point is to be sure that good internal and surface drainage are evident. Poorly drained soils are often responsible for crop failure. A good pepper soil should be relatively high in organic matter. A well drained silt loam soil will require less management than a heavier clay soil or a lighter sandy soil. As a sanitary measure in controlling diseases, avoid soils on which peppers, tomatoes, Irish potatoes, beans, cantaloupes, etc., were grown on just prior to this crop.

Proper soil preparation is necessary for all vegetable crops. Once plants are set to the field little can be done to counteract poor soil preparaion. The soil should be broken as deep as possible with conventional equipment, without turning up excessive raw subsoil. On a shallow topsoil, subsoil at rate of one-inch or so may be added. Following breaking and bed preparation the surface should be made loose and friable by harrowing. On heavier soils and soils compacted by rain between preparation and transplanting it may be necessary to use a disc harrow.

### Fertilization

Soil reaction is not as important for pepper as for certain other crops. However, complete crop failure has been observed where peppers were planted on strongly acid soils (pH 4.6 to 4.8). Soil should be tested and lime added if pH is lower than pH 5.5.

Initial fertilizers should be applied at least two to three weeks prior to transplanting. Apply all pre-transplanting fertilizer in band in the center of row and cover as the row is being prepared.

Experimental results indicate that soils low in phosphorous and potassium require 100 to 160 pounds phosphoric acid ($P_2O_5$) per acre, 60 to 80 pounds of potash ($K_2O$) per acre, and 60 to 80 pounds of nitrogen (N) per acre. If ready-mixed fertilizer is preferred, a 1:2:1 ratio at rates to supply these requirements is satisfactory.

On soils with higher levels of phosphorous and potassium, rates can be reduced considerably. In some instances rates of one or both of these plant nutrients can be reduced as much as 50 to 75 percent, on the basis of a soil test. Results in Table 1 were obtained on a soil testing extremely high in phosphorous (373 lbs. of $P_2O_5$ equivalent per acre). This shows that with a high level of phos-

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[1] Trade names of material manufactured by E. I. DuPont de Nemours and Company, Union Carbide Chemicals Company, and Food Machinery and Chemical Corporation.

**Table 1.—Influence of phosprous application on U. S. No. 1 Bell Peppers.**

| Materials Lbs. per acre | | | Hampers per acre | | |
|---|---|---|---|---|---|
| | | | 1st. harvest | 1st. & 2nd harvests | Total 7 harvests |
| N | $P_2O_5$ | $K_2O$ | | | |
| 60 | 0 | 60 | 65 | 130 | 461 |
| 60 | 80 | 40 | 136 | 212 | 456 |
| 60 | 120 | 60 | 148 | 220 | 447 |
| 60 | 160 | 80 | 142 | 213 | 423 |

phorous in the soil, rates can be reduced to 80 pounds of $P_2O_5$ per acre and still maintain maximum early yields. No difference in total yields were recorded regardless of treatment.

Additional nitrogen (32 pounds per acre) should be applied as a sidedressing at the time the first fruit are being set. Often following excessive rainfall or frequent irrigations and with a heavy set of fruit, an additional application of 32 pounds nitrogen is necessary after the second or third harvest. Neither early nor total yields have been significantly influenced by a given source of nitrogen.

## Transplanting and Cultural Practices

Plants are removed directly from the growing structure to the field. They should be 6 to 8 inches tall. Smaller or larger plants can be used but require greater care at transplanting. Plants are removed from the bed and roots "muddied" with a slurry of soil and water just prior to setting. Weak and leggy plants and those showing abnormality should be discarded.

Plants should be spaced 16 to 20 inches apart on rows 42 inches wide which are approximately 4 to 6 inches high after harrowing. Either hand setting or use of a transplanter may be employed.

After plants have become established, cultivation should be frequent enough to keep them weed free. At the time of sidedressing and with each cultivation thereafter the soil should be worked to the plant to support the main stalk and prevent lodging.

## Irrigation

Irrigation is a must for pepper production. It increases not only yields but also improves the quality of fruit. Failure to irrigate at the proper time and at correct intervals frequently causes shedding of flowers and young fruit, sunscalding, and dry rot of fruit. Water should be added at the rate of 1½ to 2 inches after the first blossoms have opened and less than ½ inch rainfall has occurred during any 10-day period. After fruits are half grown or larger and under extreme drought conditions supplementary water may be required every five to seven days. Both sprinkler and furrow type irrigations have been used successfully on this crop.

## Diseases and Insects

No attempt will be made to offer controls for all diseases and insects which occur on peppers in this bulletin. Preventive controls and recommended practices for the major diseases and insects will be listed. For description of diseases and causal organisms use Mississippi Agricultural Experiment Station Bulletin No. 453.

Bacterial spot (Xanthomonas vesicatoria) and Tobacco Mosaic (virus) are the two diseases which inflict the greatest damage in this State. The use of disease-free seed and soils on which no tomatoes or peppers have been grown for the past three years helps to prevent the incidence of these diseases. A seedbed spray schedule using a mycin preparation such as Agrimycin 100 and/or Agrimycin 500[2] should be used at regular intervals as directed on container. However, once bacterial spot occurs in the field no spray material at the present writing is effective.

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[2] Trade names for formulations of streptomycin and oxyteracyline manufactured by Charles Pfizer and Company, Inc.

To prevent the spread of mosaic (virus), plants should be sprayed with milk (dry or fresh) 24 to 48 hours before transplanting. All plant handlers should thoroughly wash hands with soap and water between smoking and handling of plants. Resistant varieties are Yolo Wonder B, Yolo Wonder L, and Keystone Resistant Giant. Their use is an effective method in preventing tobacco mosaic. Aphids must be controlled both in plant bed and the field.

The major insect problems are aphids, cutworms and tomato and tobacco hornworms. Aphids and early outbreaks of hornworms can be controlled with parathion as a one percent dust or spray. After fruit is set the use of malathion is recommended. During harvest season phosdrin should be used. In all instances these materials should be applied when the foliage is dry and according to directions supplied by manufacturers. Cutworms often cause severe damage at transplanting time. Toxaphene as a dust or spray is effective. This material is applied to the soil on top of the row just prior to transplanting at a rate of 10 to 15 pounds of 20 percent dust. If a spray is used, add spray mixture at a rate to apply two pounds of actual material per acre.

## Harvesting

An experienced picker recognizes a mature green fruit by its outward appearance. For the less experienced the color, firmness of fruit, and ease with which the fruit snaps from the plant must be considered.

Just prior to reaching the mature green stage the color of the fruit changes from yellowish light green to medium or dark green. The fruit walls are firm and will not give when a slight pressure is applied. The fruit also snaps from the plant readily when pulled. Harvest intervals often depend on weather. However, once the harvest begins, peppers should be picked every five to seven days.

Bushel baskets, hampers, or other convenient containers are used. Care should be taken to prevent damaging of the fruit as it is picked and removed from the field. Defective fruit should be discarded at the field.

Once removed from the plant, peppers are not exposed to the sun for any length of time. If packing is to be done at the farm the fruit is washed to remove any foreign material. Only sound, well-shapen to slightly misshapen fruits are used. No fruits are used where the wall has been penetrated by mechanical, insect, or disease damage. The fruit should be free from sunscald, freezing, or hail damage. Unless otherwise specified no fruit is classified as U.S. No. 1 unless the minimum dimensions are 2½ inches in diameter and 2½ inches in length.

Bushel baskets (30 lb. net) and bound crates (1 1/8 bushel) are normally used for marketing mature green peppers. Fruits are placed at random in containers to give a snug fit up to the top layer. All fruit on the top layer are placed to give a smooth and even fit with the blossom ends up. No fruit are used in this layer that detract in any way from the over-all appearance of the pack.

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# Foliar Application Of Nitrogen To Cotton

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
STATE COLLEGE MISSISSIPPI

## Summary

Field experiments on applying nitrogen to cotton leaves have been completed recently by the Experiment Station.

In contrast to soil application, foliar feeding of nitrogen to cotton during the fruiting period does not appear to be practical, even though moderate nitrogen deficiency may be corrected by spraying frequently with dilute nitrogen solutions, particularly urea.

Urea should not be applied to the foliage just to provide insurance against nitrogen deficiency, because yields may be reduced if additional nitrogen is not needed.

Solutions containing ammonium nitrate are considered unsatisfactory for foliar application to cotton. Even at low concentrations, they burn the leaves and the nitrogen is not utilized efficiently.

Biuret, in amounts commonly found in fertilizer grade urea, was not toxic to cotton when applied to the urea solution (3%N).

# FOLIAR APPLICATION OF NITROGEN TO COTTON

By W. F. JONES, J. D. LANCASTER, B. L. ARNOLD,
B. C. HURT, JR., R. E. COATS, and LOUIE WALTON

Most studies on fertilizing of cotton with nitrogen in Mississippi have considered only soil application. As a result, there is a great deal of information on the effectiveness of this practice, but very little on foliar application. Accordingly, a study was begun in 1958, to determine the response of cotton to nitrogen soluions applied to the foliage in July and August. This was compared to the response obtained from a similar amount of nitrogen applied as a side-dressing between June 15 and July 1. Leaf injury or burn, as affected by solutions of varying concentration, also was studied.

Field experiments were located (1) at the Central Station on Kaufman fine sandy loam and on Leeper-Tuscumbia clay loam (2) at the Black Belt Branch Station on Houston clay, (3) at the Brown Loam Branch Station on Falaya silt loam, (4) at the Pontotoc Ridge-Flatwoods Branch Station on Atwood fine sandy loam, and (5) at the North Mississippi Branch Station on Grenada silt loam.

The main treatments were a check, foliar applications, and a sidedress application of nitrogen. They were arranged either in a randomized complete block or a Latin Square design with a minimum of five replications. In all the tests, adequate amounts of phosphorus and potassium together with a small amount of nitrogen were applied uniformly to all plots prior to planting each year. Each plot consisted of four rows 32 feet long. The sidedress applications of nitrogen were placed in the soil along the side of the row at the conventional time for this practice.

Foliar application usually was begun the first week in July, the nitrogen solutions being sprayed on the foliage of the cotton with a small compressed-air, garden-type sprayer. To aid in uniformity, the volume of solution to be applied to each plot was divided equally and applied separately to two rows of the plot. The rate of application was usually about 20 gallons per acre. Solutions containing 3% nitrogen were applied at weekly intervals while solutions containing 5% or 6% nitrogen were applied at bi-weekly intervals. With urea-ammonium nitrate and ammonium nitrate solutions, the concentration of nitrogen was 3%, but with urea solutions, the concentration varied from 3% to 6% nitrogen.

Details of the rates and frequencies of foliar applications are given in Table 1.

The fruiting period was chosen for foliar application because during this period cotton utilizes a relatively large proportion of the total nitrogen needed for the crop, while at the same time there is sufficient leaf surface to hold a substantial volume of liquid either as droplets or as a surface film. However, since only solutions of low nitrogen content can be applied without excessive injury to the leaves, the rate of nitrogen per application is somewhat limited.

## Leaf Burn

When a solution of ammonium nitrate containing 3%N was applied to the foliage at the rate of 5 pounds of nitrogen per acre per application, the leaves were burned severely which stunted the growth of the plants and reduced the yield. Therefore, the ammonium nitrate solution was omitted from further studies after the first year.

An urea-ammonium nitrate solution containing 3% nitrogen (such solutions as uran and N-Sol 32 contain 32% N) caused noticeable leaf-burn when sprayed on the foliage at the rate of 5 pounds of nitrogen per acre per application. Consequently, urea-ammonium nitrate solutions of higher nitrogen content were not tested. Burning of the leaves by the urea-ammonium nitrate solution was expected because one-half of the nitrogen in this solution was derived from ammonium nitrate.

Solutions of urea containing 5 to 6% of nitrogen caused some burning when sprayed on the foliage. but it was not as severe as with the urea-ammonium nitrate as with the urea-ammonium ni nitrate solution (3%N). A solution of urea containing 3% nitrogen did not appear to burn the leaves appreciably. Although as will be discussed later, spraying cotton frequently with such a solution apparently reduced the yield where there was an adequate amount of available nitrogen in the soil.

## Yields

Yield results are summarized in Tables 2, 3 and 4. In Table 2, which gives the average yield for all locations and years, there appears to be little if any increase for foliar application, but the sidedress application increased the yield about 100 pounds of seed cotton per acre. (Table 2) When the results are tabulated in this

**Table 1.—Rate and frequency of nitrogen applications**

| | Lbs. N/A Preplant[1] | Lbs. N/A Sidedress | Lbs. N/A Spray | % N in Solution | No. of applications | Lbs. N/A per applications |
|---|---|---|---|---|---|---|
| 1958 | 24 | 30 | 30 | 3% | 6 | 5 |
| 1959 | 18 | 24 | 24 | 3% | 5 | 4.8 |
| | 18 | 24 | 24 | 5% | 3 | 8 |
| 1960 | 12 | 36 | 36 | 3% | 6 | 6 |
| | 12 | 36 | 36 | 6% | 3 | 12 |

[1] Preplant nitrogen applied to all treatments including the check. These plots received either side dress or spray but not both.

**Table 2.—Effect of nitrogen application on yields at 5 locations for 3 years.**

| Treatment | Pounds seed cotton/A |
|---|---|
| Check | 1471 |
| Foliar: Urea-ammonium nitrate solution (3% N) | 1423 |
| Foliar: Urea solution (3% N) | 1497 |
| Foliar: Urea solution (5%N)[1] | 1462[2] |
| Sidedress: Ammonium nitrate (33.5% N) | 1534 |

[1] Applied as 6% N in 1960.

[2] Two-years only.

**Table 3.—Effect of foliar applications of nitrogen on the yield of cotton at the Black Belt, Pontotoc Ridge, and North Mississippi Branch Stations.**

| | Yield, Pounds seed cotton per acre | |
|---|---|---|
| Treatments | 1959-60 | 1958-60 |
| Check | 1330 | 1315 |
| Foliar: Urea-ammonium nitrate solution (3% N) | 1401 | 1384 |
| Foliar: Urea solution (3% N) | 1482 | 1467 |
| Foliar: Urea solution (5% N)[1] | 1417 | |
| Sidedress: Ammonihm nitrate (33.5% N) | 1518 | 1460 |

[1] Applied as 6% N in 1960.

**Table 4.—Effect of foliar applications of nitrogen on the yield of cotton at the Brown Loam and Central Stations.**

| | Yield, Pounds seed cotton per acre | |
|---|---|---|
| Treatments | 1959-60 | 1958-60* |
| Check | 1673 | 1840 |
| Foliar: Urea-ammonium nitrate solution (3% N) | 1469 | 1651 |
| Foliar: Urea solution (3% N) | 1522 | 1687 |
| Foliar: Urea solution (5% N)[1] | 1534 | |
| Sidedress: Ammonium nitrate (33.5% N) | 1634 | 1772 |

*At Brown Loam Station Only

[1] Applied as 6% N in 1960

way, it might be concluded that foliar application of nitrogen to cotton is ineffective even though there is a need for additional nitrogen for optimum yield. However, when the results are summarized according to response, or lack of response to a sidedress application a different conclusion is drawn.

According to results in Table 3, for locations showing a response to nitrogen sidedressing, it is evident that foliar application increased the yield. The foliar applied urea solution containing 3% N was as effective as was the sidedressed ammonium nitrate, but the urea-ammoninum nitrate (3% N) and the more concentrated urea solutions (5-6% N) were not. The yield increase for these solutions was a little less than one-half as much as was obtained with sidedressed ammonium nitrate, or with the less concentrate urea solution (3% N). Failure of the urea-ammonium nitrate solution (3% N) to be as effective as the urea solution containing 3% N is attributed to leaf-injury (burning) from the ammonium nitrate while the failure of the urea solutions containing 5-6% may be attributed in part to leaf-injury and possibly to less frequent application as well. Although the urea solutions containing 5-6% N burned the leaves, the degree of burning was not as great as with the urea-ammonium nitrate solution. Even so, it is highly improbable that an urea solution containing 6% nitrogen would be as effective for foliar application as one containing 3% nitrogen when both the frequency and the rate of application of nitrogen per acre are the same. Solutions of urea containing 4% nitrogen are perhaps about as concentrated as should be employed for foliar application to cotton.

Results for locations where there was no increase in yield from a sidedress applications are shown in Table 4. From these results it is evident that foliar application as carried out in these tests actually reduced the yield where enough nitrogen was already available in the soil. The urea-ammonium nitrate solution caused the greatest reduction in yield, which again indicates that it injured the leaves more than did the other solutions. Also, it is apparent that foliar application of urea solutions as concentrated as those reported herein should be made to cotton, only where nitrogen deficiency is recognized and not as a general practice just to provide insurance against the development of nitrogen deficiency.

## With Insecticides?

There has been some interest in the possibility of supplementing soil application of nitrogen with foliar application by adding urea to the insecticide and spraying both on at the same time. However, in terms of the frequency of application and the volume of insecticide per application, relatively small amounts of nitrogen would be applied in this way using the most concentrated solutions of urea that appear to be feasible.

For example, with ground equipment the volume of insecticide per acre per application during the fruiting season probably does not average more than 5 gallons, and if applied by airplane, the volume perhaps does not average 2 gallons per acre. Therefore, for a nitrogen concentration of 3% as urea, one gallon of insecticide would contain approximately one-third pound of nitrogen. Thus, with ground equipment, the average rate of nitrogen per application of insecticide would be about 1.7 pounds per acre, and with aerial application, about 0.6 pound per acre. Should foliar application of nitrogen with the insecticide be commenced upon recognition of nitrogen deficiency in late July—after which 8 applications of insecticide were made—then ground equipment would apply a total of 14 pounds of nitrogen per acre, and aerial equipment, about 5 pounds per acre.

This is not enough nitrogen to correct a noticeable deficiency. Thus, either the concentration of urea or volume of solution must be increased. If formulated with enough water to give 16 to 20 gallons per acre, an insecticide solution containing 3% nitrogen would give a per-acre rate of nitrogen of 4 to 5 pounds per application, which would be sufficient to correct a recognizable nitrogen deficiency if 5 or more applications were made. However, because of the volume of solution involved, this would be entirely impractical with aerial equipment and possibly with ground equipment as well.

Even though a moderate nitrogen deficiency may be corrected by foliar application, it is probable that the need for such a practice will seldom arise where recommended practices for soil application are followed. Should a deficiency result because of excessive leaching from very sandy soils during rainy periods or because of gaseous loss of nitrogen by denitrification from clayey soils which have become water-logged, it is highly probable that the deficiency will occur early enough in the growing season for a soil application to correct it. In most cases, nitrogen deficiency in cotton in July can be corrected as effectively by soil as by foliar application even though it may be necessary to apply the nitrogen on the surface of the soil. For late-season surface applications, faster and more efficient utilization will be made if a source high in nitrate nitrogen is used.

## Corrosion

Urea solutions are not corrosive to iron, steel, aluminum, fiber glass, and plastics, such as nylon; but galvanized metals, copper and brass may be corroded slightly. Therefore, if urea is to be sprayed with the insecticide, equipment should be made of materials that are not corroded by it. In most cases, this will amount to no more than substituting aluminum, stainless seel, or nylon nozzles for brass nozzles which are commonly used.

Ammonium nitrate solutions corrode iron and steel readily and copper, brass and galvanized metal are rapidly and severely corroded. Therefore, such solutions should not be applied with equipment commonly used for insecticides.

Fertilizer-grade urea is conditioned to improve its physical properties during storage and application by coating the prills with clay, or some other material which may be insoluble in water. For this reason, fertilizer grade urea is likely to be unsuitable for foliar application because the clay, or other conditioner would plug up the spray nozzles. Feed-grade urea would be satisfactory as it is not conditioned.

## Biuret

In the production of urea, some biuret is formed. Fertilizer-grade urea usually contains from 1 to 2% biuret. It has been found that biuret in solution is very toxic to citrus fruit when sprayed on the foliage.

A test was conducted to determine the toxicity of biuret to cotton when sprayed on the foliage in varying concentrations. The application schedule is shown in Table 5. To provide a check, a biuret-free solution of urea (3% N) was spray-

**Table 5.—Effect of foliar applications of biuret in urea on the yield of cotton.**

| Total-lbs./A | | Lbs./A Per application | | No. of applications | | Lbs. seed |
|---|---|---|---|---|---|---|
| Biuret | N as Urea | Biuret | N as Urea | Biuret | N as Urea | cotton/A |
| 0 | 0 | 0 | 0 | 0 | 0 | 1593 |
| 0 | 36 | 0 | 6 | 0 | 6 | 1483 |
| 0.6 | 36 | 0.1 | 6 | 6 | 6 | 1460 |
| 1.2 | 36 | 0.2 | 6 | 6 | 6 | 1503 |
| 2.4 | 36 | 0.4 | 6 | 6 | 6 | 1437 |
| 2.4 | 36 | 0.8 | 6 | 3 | 6 | 1497 |

Biuret applied in an urea solution containing 3% nitrogen.
18-54-54 base application.
Sidedress with 54 lbs. N/A.

ed on the foliage at weekly intervals at the rate of 6 pounds of nitrogen per acre per application. Foliar application was begun the first week of July and a total of 6 applications were made. Varying amounts of biuret were added to identical urea solutions and applied to the cotton at weekly intervals as was the urea solution on the check plot.

According to results shown in Table 5, foliar application of urea again reduced the yield but the yield was not reduced further by adding biuret to the urea solution. The highest rate of biuret, 2.4 pounds per acre, is equivalent to a per-acre rate of 160 pounds of urea containing 1.5% biuret. It is highly unlikely that a larger amount would ever be applied.

Therefore, it appears that the amount of biuret commonly found in fertilizer grade urea is not toxic to cotton when applied to the foliage with urea solutions containing 3 to 6% nitrogen.

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# Some Factors Affecting Chemical Changes Occurring in Fats

## At The Temperature Used in Deep-Fat Frying

By
ANN R. STASCH
and
LOIS KILGORE

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Mississippi State University
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HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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# SOME FACTORS AFFECTING CHEMICAL CHANGES OCCURING IN FATS AT THE TEMPERATURE USED IN DEEP-FAT FRYING

By

Ann R. Stasch and Lois Kilgore

## INTRODUCTION

Ingestion of fats heated at temperatures commonly used for deep-fat frying has been reported to cause a large variety of ailments ranging in severity all the way from simple irritation of the digestive tract to gastric cancer. Therefore, along with concern over ingesting the quantity of fat usually associated with deep-fat fried foods, the homemaker often questions a nutritional hazard resulting from the fat itself.

There is no doubt that regular use of deep-fat fried foods increases the total amount of fat ingested. Their use may be extremely undesirable to an individual from a medical standpoint. However, there is little basis for questioning the actual safety of the fat consumed with deep-fat fried foods.

The homemaker is advised to take sensible precautions to prevent overheating and overlong use of fats. However the average homemaker does not do deep-fat frying every day. Since this method of cooking requires a large amount of fat, which is relatively expensive, the fat is saved and re-used many times. Also, homemakers show prejudice in their choice of a frying pan, some using nothing but an iron frying pan, and others completely avoiding the use of either iron or aluminum frying pans. Since metals catalyze oxdiative reactions of fats, it might be of interest to determine whether the kind of frying pan used has any effect on chemical changes occuring in fats during heating.

## REVIEW OF THE LITERATURE

### Biological Effects of Feeding Heated and Aerated Fats

Various workers have fed oxidized fats to rats with widely differing results, presumably dependent upon the extent of oxidation. Some of the adverse biological effects reported to result from the use of such diets are: decreased intake of food, loss of weight, severe diarrhea and rough fur (16); increased caloric requirement for weight maintenance (19); decreased absorption of fat and higher protein requirement (12); decreased hemoglobin, red and white cell counts (6); slight enlargement of the liver and, in female rats, enlarged thymus and pituitary glands (10). No permanent damage results and when rats fed oxidized oil are returned to a diet containing only fresh unheated oil the symptoms disappear completely, leaving no signs of subsequent injury (16, 18).

Many of the above studies were carried out using fats which had been heated to higher temperatures than would normally be used for cooking, or which had been vigorously stirred and aerated during the heating process. Moreover, the heated fat was fed to the rats in amounts ranging from 10-30 percent of their total intake of food. Several studies made on fat taken from commercial potato chip manufacturers show that changes in the fat are not severe enough to cause any adverse biological effect (23).

It is difficult to state exact values for any chemical analyses which can be associated with the onset of adverse biological effects. The analytical values obtained vary with the type of fat used as well as with its treatment. Onset of foaming in fats has been reported to occur at about the same time as the beginning of change in biological effect (26). A drop of five percent in unsaturation in cottonseed oil was reported insufficient to impair growth, reproduction, lactation or longevity of rats (23). Concentrations of free fatty acids of above 0.2 percent have been reported to impart objectionable flavors to fats (25).

### Chemical Changes Occurring During Heating of Fats

Long continued heating of fats causes changes in their chemical structure and composition. Although chemical changes vary in severity with the conditions under which the fat is heated, the following changes seem characteristic of all heated fats: increases in free fatty acids and peroxides (21, 23), carbonyl compounds (5, 11, 23), viscosity (25, 26) and unsaturation (20); decrease in unsaturation (9, 21, 23); gum formation (25); foaming (26); and development of brownish-red colors (4).

### Oxidative Changes in Fat

Common oxidative rancidity occurs in edible fats due to a free radical reaction of the fat with oxygen from the air. The process is called autoxidation since it is spontaneous. Metallic ions such as iron apparently serve as initiators of the chain reaction mechanism, and thus catalyze the reaction. Autoxidation reactions occurring in fats are accelerated at high temperatures such as those necessary for deep-fat frying (22).

The fat becomes less unsaturated as a result of autoxidation since the unsaturated bonds in the fatty acids serve as a locus for the reaction with oxygen. The first products formed from reaction with oxygen are hydroperoxides. Heat decomposition of the hydroperoxides results in the formation of various acids and carbonyl compounds (aldehydes and ketones) (22). The latter compounds are largely responsible for the rancid or "off" flavors developed in fats (5). Carbonyl compound serve an additional function also, in tha unsaturated aldehydes, such as 2,4-decadienal, have been found to occur during autoxidation of all fats in amounts corresponding to the amount of linoleic acid present, and are reported to be responsible for the deep-fat fried odor common to foods so prepared (24). Therefore, the same autoxidation reactions give us the desirable flavor of deep-fat fried foods as well as the characteristic undesirable flavor of rancid fats.

### Effect of Metal Catalysis on Autoxidation

A survey of Home Demonstration Club women in Oktibbeha County, Mississippi, showed that 54 percent of these women most often used an iron frying pan for frying, 22 percent each most often used stainless steel or aluminum and 2 percent most often used glass ceramic (28). This preference for the use of an iron frying pan, coupled with the fact that metals are known to act as catalysts for autoxidation of fats, indicates a need for further study. Parallel experiments using fats heated in the various kinds of frying pans commonly used could determine whether the use of metal pans, particularly iron, has any measurable effect on chemical changes in fats.

In one such reported study successive batches of potatoes were fried in cottonseed oil heated for a total of seven hours under the same conditions in both iron and aluminum pans. Analysis of the fat after use showed that fat heated in the aluminum pan underwent a greater decrease in unsaturation, whereas that heated in iron showed a greater development of peroxides and free fatty acids. A comparison of both of the laboratory heated fats with that used in an iron pan during a commercial frying process showed that the laboratory heated fat had lost more of its unsaturation and had gained more peroxides than its commercial counterpart. The commercially heated oil had a higher concentration of free fatty acids, however (7).

Prolonged heating of fats in the same frying pan permits formation of an oxidized oil film on the surface of the pan (13). The presence of such a film might hinder or eliminate any catalytic effects resulting from the use of metal frying pans. However, it has been reported recently that cleansing of deep-fat fryers between uses prolongs the frying life of fats (27). A consideration of both these observations makes it appear that any catalytic effect arising from the use of metal frying pans is of minor importance in the usable frying life of a fat.

## OBJECTIVES AND PROCEDURE

The aim of this project was to provide nformation for the homemaker, and others interested in deep-fat frying procedures, concerning some of the oxidaive changes occurring in fats used for deep-fat frying under simulated home onditions and to determine whether the kind of frying pan and the type of fat used had any effect on such changes. Such information will serve as a criterion for judging whether present procedures n the use and storage of fats for deep-fat frying result in changes which could possibly create a nutritional hazard.

Four types of fats commonly used for deep-fat frying were purchased at local markets. These were: a vegetable oil; a hydrogenated vegetable shortening, a hydrogenated combination animal-vegetable shortening; and a lard (animal fat). These fats were heated in the four kinds of frying pans commonly used in home kitchens—iron, aluminum, stainless steel and glass ceramic. Each frying pan had approximately the same surface area (100 square inches).

Since there was a significant variation in the results of chemical analyses of different containers of the same fat as purchased, the contents of enough of these containers were mixed so that a uniform batch of each fat could be obtained for each experiment. Approximately 2½ pounds of fat were placed in each frying pan for most of the heating experiments. Pans were heated at 185° + or − 5°C. (365°F.) on an ordinary kitchen electric range. Temperature was kept constant by using a thermometer which served also as a stirring rod to agitate the fat and continually renew the surface exposed to the air.

All samples were removed from the fats immediately after the heating period. No fresh fat was added to replace the volume lost by sampling. In general, all fats after heating were transferred from the frying pans to glass beakers, cooled to room temperature, and stored uncovered at 9°C. (48°F.) until the next heating period.

Chemical analyses were made using the following methods: Hanus iodine numbers (2); free fatty acids (3); carbonyl compounds (15, modified to read total carbonyl compounds at 490 millimicrons); and peroxide values (1).

## RESULTS AND DISCUSSION

### Effect of Frying Various Foods on Chemical Changes in a Vegetable Oil

Different samples of a vegetable oil were used to cook various kinds of foods, selected at random, in iron or aluminum pans. No temperature controls were made and the various foods were cooked for different lengths of time, just as they would have been under actual use in a home kitchen. The analytical results in

Table 1, therefore, represent changes which might actually occur during one time use of fats for deep-fat frying in a home kitchen. Regardless of the food cooked the fat showed increased amounts of carbonyl compounds and free fatty acids after use. The changes were slight and appeared to be of the same order of magnitude in each kind of frying pan. Changes in peroxide values after use of fat varied in magnitude from none when non-breaded chicken was fried in an iron frying pan, to an increase of slightly more than five times when french-fried potatoes were fried in an aluminum frying pan. The results show no particular order of change with any of the various types of food fried and are of interest only from the standpoint of showing that changes in fat occur even with mimimal use.

## Effect of Heating on Changes During Storage at Room Temperature

A batch of vegetable oil was divided into three portions and treated as follows: (1) Not heated, stored in a glass jar at room temperature for 44 days; (2) Heated once for two hours in an iron frying pan, stored in a glass jar at room temperature for 44 days, with no further heating; (3) Heated for five successive two hour periods in an iron frying pan at random time intervals over a period of 44 days, stored in a glass jar at room temperature between heating periods. Each time portion 3 was heated, samples were analyzed from all jars. Results are given in Table 2. Storage of unheated fat for a period of 44 days at room temperature resulted in some autoxidation, indicated by the continual increase in peroxide

Table 1.—Effect of one-time frying of certain foods on chemical changes in a vegetable oil.

| Sample | Free Fatty Acids % (calculated as oleic acid) | | Total Carbonyl Compounds % | | Peroxide Values mg/kg | |
|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After |
| **Iron frying pan** | | | | | | |
| Beef steaks | 0.04 | 0.27 | 0.02 | 0.03 | 1.66 | 3.34 |
| Non-breaded chicken | 0.02 | 0.04 | 0.01 | 0.05 | 1.52 | 1.53 |
| French-fried potatoes | 0.03 | 0.04 | 0.02 | 0.05 | 1.31 | 2.18 |
| Breaded shrimp | 0.03 | 0.05 | 0.02 | 0.04 | 1.31 | 5.87 |
| Pork liver | 0.02 | 0.07 | 0.02 | 0.03 | 0.73 | 1.42 |
| **Aluminum frying pan** | | | | | | |
| Breaded chicken | 0.06 | 0.15 | 0.08 | 0.08 | 1.38 | 4.67 |
| French-fried potatoes | 0.02 | 0.02 | 0.04 | 0.08 | 1.93 | 9.77 |

Table 2.—Chemical changes in heated and unheated fats during storage at room temperature.

| Times heated (5 times heated sample) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Days storage (all samples) | 0 | 0 | 3 | 12 | 23 | 44 |
| Samples: | | | Peroxide values, mg/kg | | | |
| Unheated | 1.89 | ... | 2.37 | 5.88 | 7.01 | 12.92 |
| Once heated | ... | 5.48 | 12.12 | 12.31 | 11.17 | 13.16 |
| 5 times heated | ... | 9.06 | 14.03 | 11.60 | 1.95 | 4.31 |
| | | | Free fatty acids, % (calculated as oleic acid) | | | |
| Unheated | 0.04 | ... | 0.02 | 0.04 | 0.03 | 0.03 |
| Once heated | ... | 0.18 | 0.12 | 0.17 | 0.11 | 0.15 |
| 5 times heated | ... | 0.19 | 0.25 | 0.30 | 0.32 | 0.57 |
| | | | Total carbonyl compounds, % | | | |
| Unheated | 0.05 | ... | 0.05 | 0.06 | 0.06 | 0.07 |
| Once heated | ... | 0.37 | 0.36 | 0.37 | 0.38 | 0.46 |
| 5 times heated | ... | 0.41 | 0.58 | 0.66 | 0.73 | 0.34 |

values. Increase in peroxide values during storage occurred also in fat which had been heated one time before it was stored. Although amounts of free fatty acids and carbonyl compounds remained approximately the same during storage of both unheated and once heated fat, concentrations of these compounds were higher in the once heated than in the unheated fat. Both carbonyl compounds and free fatty acids increased in the repeatedly heated fat with each additional heating, whereas peroxide values decreased. The decrease in peroxide values was expected since peroxides are destroyed by heat. Since both carbonyl compounds and free fatty acids form as products from the breakdown of peroxides, their relationship in heated fat shows a negative correlation; that is, carbonyl compounds increase as peroxides decrease.

Although peroxides already present in the fat are destroyed by heating, more form in the fat as it cools. To determine the rate and extent of peroxide formation during cooling and its effect on carbonyl compounds, samples of a vegetable oil heated for five hours in an iron frying pan were analyzed immediately after heating and at the following time intervals thereafter: 15 minute intervals for the first hour; 30 minute intervals for the next 2 hours; and 24 hour intervals for 4 days. The fat was divided into two portions after it had cooled for two hours. One portion was kept at room temperature and the other was stored in a refrigerator at 48°F. Samples from both portions of fat were analyzed at each sampling time in order to compare refrigerated storage with that at room temperature. Data are presented in Table 3.

The concentration of peroxides increased rapidly during the time immediately after heating and slowed to a very gradual increase during each succeeding day's storage. The increase in peroxides showed a significant positive correlation ($r = +0.76$)* with increase in carbonyl compounds, which is opposite to the correlation obtained with repeatedly heated samples. Therefore, some increase in carbonyl compounds occurs during storage, although a far greater amount occurs as a direct result of peroxide decomposition during the heating process.

During the limited storage period studied there was not much difference between fat stored at room temperature and that stored in a refrigerator except that

**Table 3.—Rate of change in peroxide values and carbonyl compounds with time after heating.**

| Time | | Carbonyl Compounds,% | | | | Peroxide Values, mg/kg | | | |
|---|---|---|---|---|---|---|---|---|---|
| after | Frying pan | Iron | | Glass Ceramic | | Iron | | Glass Ceramic | |
| heating | Storage temp. | Room | 9°C. | Room | 9°C. | Room | 9°C. | Room | 9°C. |
| Hours: | | | | | | | | | |
| 0.00 | | 0.39 | | 0.44 | | 1.65 | | 1.17 | |
| 0.25 | | 0.52 | | 0.34 | | 4.23 | | 3.62 | |
| 0.50 | | 0.35 | | 0.38 | | 5.03 | | 4.31 | |
| 0.75 | | 0.37 | | 0.45 | | 5.81 | | 2.46 | |
| 1.00 | | 0.37 | | 0.42 | | 5.73 | | 6.42 | |
| 1.50 | | 0.38 | | 0.39 | | 5.79 | | 2.46 | |
| 2.00 | | 0.37 | | 0.38 | | 5.14 | | 6.10 | |
| 2.50 | | 0.44 | 0.37 | 0.38 | 0.38 | 2.79 | 6.88 | 6.88 | 6.71 |
| 3.00 | | 0.40 | 0.38 | 0.38 | 0.37 | 5.04 | 6.07 | 6.69 | 6.83 |
| 24.00 | | 0.52 | 0.53 | 0.56 | 0.45 | 6.09 | 5.89 | 6.82 | 6.25 |
| 48.00 | | 0.54 | 0.55 | 0.53 | 0.54 | 4.68 | 4.89 | 7.23 | 5.45 |
| 72.00 | | 0.65 | 0.59 | 0.58 | 0.54 | 7.03 | 3.51 | 6.94 | 5.88 |
| 96.00 | | 0.53 | 0.66 | 0.57 | 0.55 | 8.60 | 6.01 | 9.25 | 6.87 |

---

* r required for significance at the 5% level (66df) = .239; at the 1% level = .311.

slightly greater amounts of peroxides formed at room temperature.

### Effect of Amount of Fat Used for Deep-Fat Frying

Change in amount of fat heated per unit of surface area has been reported to have more influence on chemical changes than change in temperature (26). To determine whether this was true for all types of fat in all kinds of frying pans, portions of the same batch of each fat were heated at depths of both one inch and one-half inch in each kind of frying pan. All fats were heated for a total of 30 hours and analyzed at the end of this time. Means for all fats for each pan and all pans for each fat are given in Tables 4 and 5.

When fats are heated at a depth of one-half inch the trend is toward higher values for carbonyl compounds and free fatty acids and lower values for peroxides and iodine numbers. These changes are in the direction of a greater breakdown of fat when less of it is heated regardless of the kind of frying pan used.

Mean values show that the fats ranked from the highest to the lowest for each chemical analysis as follows: carbonyl compounds — lard, vegetable oil, hydrogenated vegetable shortening, hydrogenated combination shortening; peroxide values — hydrogenated vegetable shortening, lard, hydrogenated combination shortening, vegetable oil; iodine numbers — vegetable oil, hydrogenated vegetable shortening, hydrogenated combination shortening, lard; and free fatty acids — hydrogenated combination shortening, lard, hydrogenated vegetable shortening, vegetable oil. Thus, no one type of fat shows a consistently greater chemical change than any other. The results indicate that lard and the hydrogenated combination shortening usually behave similarly when heated, whereas the vegetable oil and the hydrogenated vegetable shortening may or may not.

Regardless of the type of fat or the kind of frying pan used, larger amounts of

Table 4.—Mean values for chemical analyses for all fats heated at each depth in each kind of frying pan.

| Frying pan | Depth | Iodine numbers | Peroxide values | Free fatty acids | Total carbonyl compounds |
|---|---|---|---|---|---|
| | Inches | Hanus | mg/kg | (calculated as oleic acid) % | % |
| Iron | 0.5 | 42.07 | 3.92 | 2.76 | 0.64 |
| Iron | 1.0 | 51.00 | 3.93 | 1.45 | 0.59 |
| Aluminum | 0.5 | 49.00 | 4.16 | 2.18 | 0.81 |
| Aluminum | 1.0 | 52.26 | 4.60 | 1.45 | 0.63 |
| Stainless steel | 0.5 | 44.80 | 4.62 | 2.13 | 0.63 |
| Stainless steel | 1.0 | 50.71 | 4.63 | 1.41 | 0.51 |
| Glass | 0.5 | 42.48 | 5.19 | 2.40 | 0.57 |
| Glass | 1.0 | 48.03 | 6.04 | 1.70 | 0.53 |

Table 5.—Mean values for all frying pans for each chemical analysis on each type of fat.

| Fat: Analysis | Vegetable oil | Hydrogenated vegetable shortening | Hydrogenated combination shortening | Lard |
|---|---|---|---|---|
| Iodine numbers, Hanus | 67.02 | 48.07 | 38.98 | 36.10 |
| Peroxide values, mg/kg | 1.61 | 8.84 | 3.98 | 4.12 |
| Free fatty acids, % (calculated as oleic acid) | 1.05 | 1.92 | 2.39 | 2.39 |
| Carbonyl compounds, % | 0.70 | 0.60 | 0.44 | 0.72 |

fat result in less chemical change during heating. Use of maximum amounts of fat for deep-fat frying is a practice which the homemaker can easily follow. Aside from the lesser effect of heating noted here on larger volumes of fat, this practice has an added advantage. The addition of fresh fat each time the fat is used, to replace that lost during the previous cooking, results in dilution of chemical changes.

### Effect of Extended Heating of All Fats in All Kinds of Frying Pans

Two different batches of each type of fat were heated in each kind of frying pan for 10 5-hour heating periods. Samples were removed after each ten hours of heating and stored in brown glass jars at 9°C. until they were analyzed. The error introduced by failure to replace the volume of fat removed for each sample was unavoidable.

The fat in the metal frying pans, particularly iron and stainless steel, reached the desired temperature of 185°C. more rapidly than did the fat in the glass ceramic frying pan; but the maintenance of desired temperature was easier in the glass ceramic pan due to its good heat retention.

At no time during the heating period did any of the fats develop undesirable odors or flavors characteristic of rancidity. The fats became very viscous by the end of the 50 hour heating period. The development of a reddish-brown color in all fats occurred during the first five hours of heating. Color development was most pronounced in the iron pan, about the same in aluminum and stainless steel, and least in the glass ceramic pan. The color developed steadily throughout the 10 heating periods and was so pronounced by the end of the total heating period that this alone would have prevented use of the fats. When french-fried potatoes were fried in this fat a great deal of foaming occurred. Although the potatoes were judged acceptable in taste and appearance, the amount of foam formation would have constituted a fire hazard if this fat had been used in the home.

Analysis of variance of the combined data, presented in Table 6, showed that results of all analyses varied significantly with length of time of heating and with the type of fat used. All analyses except that of iodine number varied significantly with the kind of frying pan used. Tables 7, 8, 9, and 10 show the results of further statistical analysis of the experimental data. These results are discussed below.

#### 1. Differences Related to Length of Time of Heating.

All fats became less unsaturated as a result of heating. The decrease in unsaturation for each 10-hour heating period was approximately the same through 40 hours of heating. Between 40 and 50 hours, however, the decrease was negligible. The mean decrease in unsaturation for all fats between 10 and 50 hours of heating was 26.66 percent. A five percent decrease in unsaturation is not considered harmful. The decrease in unsaturation found here is considerably greater than five percent, and is also greater than the three percent decrease reported to occur during the use of fat for commercial manufacture of potato chips. A decrease of 26.66 percent in unsaturation, coupled with the fact that severe foam formation occurred, indicates that adverse biological effects would have occurred in rats fed quantities of any of these 50-hour heated fats.

Concentrations of free fatty acids, which increased with each 10 hours of heating, were higher than values reported to cause off-flavor defects in fat, although, as previously stated, no off-flavor was noted in these fats. The amounts of carbonyl compounds present in each fat also increased during the 50 hours of

Table 6.—F ratios obtained from analysis of variance of fats heated 50 hours in different frying pans.

| Source | Degrees of freedom | F Ratios | | | |
|---|---|---|---|---|---|
| | | Peroxide values | Total carbonyl compounds | Free fatty acids | Iodine numbers |
| Hours of heating (H) | 4 | 19.43** | 13.37** | 73.42** | 35.51** |
| Frying pans (P) | 3 | 6.81** | 3.78* | 6.49** | n.s. |
| Fats (F) | 3 | 7.26** | 82.27** | 75.83** | 107.44** |
| H x P Interaction | 12 | n.s. | n.s. | n.s. | n.s. |
| H x F Interaction | 12 | 4.73** | n.s. | n.s. | n.s. |
| P x F Interaction | 36 | n..s | n.s. | n.s. | n.s. |
| H x P x F Interaction | 9 | n.s. | n.s. | n.s. | n.s. |
| Replicates | 1 | | | | |
| Error | 79 | | | | |

**Differences significant at 1% level.
*Differences significant at 5% level.
n.s. Not significant.

Table 7.—Mean values for all fats for all lengths of time of heating, showing significant differences between types of frying pans.*

| Frying pan: | Iron | Aluminum | Stainless Steel | Glass Ceramic |
|---|---|---|---|---|
| | Mean peroxide values, mg/kg | | | |
| | 1.82a | 1.84a | 2.16a | 2.73b |
| | Mean free fatty acids (calculated as oleic acid), % | | | |
| | 0.92a | 0.88a | 0.95a | 1.10b |
| | Mean total carbonyl compounds, % | | | |
| | 0.56a | 0.54ab | 0.47bc | 0.45c |

*Any values not followed by the same letter differ significantly at the 5% level of probability by Tukey's Honestly Significantly Difference Test (29).

Table 8.—Mean values for all fats and all kinds of frying pans showing significant differences between lengths of time of heating.*

| Time: Hours | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| | Mean iodine numbers, Hanus | | | | |
| | 64.25a | 57.80b | 53.59c | 48.12d | 47.71e |
| | Mean free fatty acids (calculated as oleic acid), % | | | | |
| | 0.49a | 0.74b | 1.00c | 1.21d | 1.37e |
| | Mean total carbonyl compounds, % | | | | |
| | 0.33a | 0.47b | 0.53bc | 0.58cd | 0.62d |

*Any values not followed by the same letter differ significantly from one another at the 5% level of probability by Tukey's Honestly Significant Difference Test (29).

Table 9.—Mean values for all lengths of time of heating and all frying pans, showing significant differences between types of fat.*

| Fat: | Vegetable oil | Hydrogenated vegetable shortening | Hydrogenated combination shortening | Lard |
|---|---|---|---|---|
| | Mean iodine numbers, Hanus | | | |
| | 69.45a | 54.70b | 46.39c | 46.65c |
| | Mean free fatty acids (calculated as oleic acid), % | | | |
| | 0.51a | 0.96b | 1.16c | 1.22c |
| | Mean total carbonyl compounds, % | | | |
| | 0.88a | 0.37bc | 0.31b | 0.46c |

*Any values not followed by the same letter differ significantly at the 1% level of probability by Tukey's Honestly Significant Difference Test (29).

**Table 10.—Significant differences between treatment means for each fat at each different length of time of heating.***

| Fat: | Vegetable oil | Hydrogenated vegetable shortening | Hydrogenated combination shortening | Lard |
|---|---|---|---|---|
| Heating time: **Hours** | | mean peroxide values, mg/kg | | |
| 10 | 5.04a | 2.85b | 2.24b | 3.24b |
| 20 | 4.27a | 2.04b | 1.57b | 1.72b |
| 30 | 2.30a | 2.58a | 1.57a | 1.74a |
| 40 | 1.06a | 1.89a | 1.90a | 1.98a |
| 50 | 1.11a | 1.06a | 1.35a | 1.28a |

*Any values not followed by the same letter differ significantly at the 1% level of probability by Tukey's Honestly Significant Difference Test (29).

heating. The greatest amount of change in both free fatty acids and carbonyl compounds occurred between the 10 and 20 hour heated samples. Since color development was also quite severe after 20 hours of heating, the maximum practical time of use for all fats is presumed to lie somewhere between 10 and 20 hours of heating.

The concentration of peroxides found in the fats decreased with increased length of time of heating. Since peroxides are destroyed by heating, it is difficult to interpret the significance of this. However, since all samples were analyzed at the same length of time after heating, the total variation found in peroxide concentration cannot be attributed to formation of peroxides during storage.

### 2. Differences Related to Type of Fat.

In general, the lard and the hydrogenated combination shortening were similar in behavior, whereas the behavior of the vegetable oil was quite different from that of the hydrogenated vegetable shortening. The homemaker interested in unsaturated fat would find that, even after heating, the vegetable oil remains more unsaturated than any of the other fats. No significant difference exists between the lard and the hydrogenated combination shortening which are the least unsaturated of the fats studied. Free fatty acids were highest in lard and hydrogenated combination shortening, and lowest in vegetable oil. The vegetable oil contained more carbonyl compounds than any of the other fats. Since carbonyl compounds are major flavor components of fats, this may provide some justification for the commonly held assumption that use of a vegetable oil for frying gives an improved flavor to fried foods. Peroxide values were higher in the vegetable oil than in the other fats after both 10 and 20 hours of heating, but no difference between fats was found after 30 hours of heating. Except for a possible flavor consideration, there seems little justification for choice of any one fat in preference to any other.

### 3. Differences Related to Kind of Frying Pan.

All fats heated in glass ceramic frying pans had higher peroxide values than fats heated in iron frying pans, greater amounts of free fatty acids than fats heated in any of the metal pans, and smaller amounts of carbonyl compounds than fats heated in either iron or aluminum frying pans.

Significant correlations between amounts of peroxide values and free fatty acids were found for all the metal pans but not for the glass ceramic pan, showing that as peroxide values decreased, free fatty acids increased (iron: $r = -.55$; aluminum: $r = -.59$; stainless steel: $r = -.47$; glass ceramic: $r = -.31$)*. For all types of frying pans fats showed a significant correlation between decrease in iodine number and increase in free fatty acids (iron: r = −.72; aluminum: r = −.69; stainless steel: r = −.71; glass ceramic: r = −.74)*. The correlation between increase in free fatty acids and decrease in peroxide values appears to indicate a catalytic effect from the metal pans. The significant correlation between decrease in iodine number and increase in free fatty acids is almost certainly related to the autoxidation reactions occurring as a result of heating the fats.

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*r required for significance at the 5% level (38 df) = .399; at the 1% level = .437.

Mean values for amounts of total carbonyl compounds were found to increase in the fats heated in the various frying pans in the following order: glass ceramic, stainless steel, aluminum and iron. The development of higher concentrations of carbonyl compounds in fats heated in an iron frying pan may be of significance in the development of flavor in fried foods, as a number of the desirable flavor components in fried foods are unsaturated aldehyde compounds. This may explain the often heard statement that "foods fried in an iron pan taste better".

Fats heated in glass ceramic frying pans contain the greatest amounts of free fatty acids and peroxides. As previously stated, the peroxide values may result from storage of the fat samples rather than heating of the fats. However, the fact that significantly greater amounts of peroxides were found in fats heated in glass ceramic pans might also indicate either that greater amounts of peroxides were destroyed during heating of fats in the metal pans or during cooling of these fats before storage. In other words, the peroxide concentrations also may demonstrate a statistically significant catalytic effect resulting from use of the metal frying pans.

The greater amount of free fatty acids in the glass ceramic pan and the greater amounts of carbonyl compounds in the iron frying pan demonstrate the catalytic effect of iron in formation of carbonyl compounds from free fatty acids.

The slight differences in end products of oxidation discussed above, namely, free fatty acids versus carbonyl compounds, show a statistically significant catalytic effect on autoxidation of fats by the metal frying pans in general, and by the iron frying pan in particular.

Increase in length of time of heating causes greater chemical changes in fats than kind of frying pan or type of fat used.

## SUMMARY AND CONCLUSIONS

Fats which have undergone prolonged heating at high temperatures, such as those used for deep-fat frying, are subject to chemical changes which may have an adverse effect on their nutritional value. Such changes are accelerated by certain metallic ions, such as iron. Homemakers who do not regularly use deep-fat frying as a method of food preparation store the fat from deep-fat frying for re-use at irregular intervals. Deep-fat frying is commonly carried out in an iron frying pan or other metallic container which may accelerate the oxidation reactions occurring in fats during heating.

This project was carried out to determine whether certain kinds of frying pans or certain types of fats cause greater chemical changes than others during prolonged heating and storage.

The four types of fat studied were: a vegetable oil, a hydrogenated vegetable shortening, a hydrogenated combination shortening and a lard. The fats were heated in iron, aluminum, stainless steel, and glass ceramic frying pans, since these are commonly used in home kitchens.

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*See footnote page 11.

Autoxidation reactions occurred even during minimal use of fat such as one time cooking of various meats, poultry, or french-fried potatoes. A large variation in chemical changes in the fat resulted from such use, due either to the kind of food cooked or to differences in time and temperature of heating.

Heating of fat causes considerably greater chemical change than storage at room temperature except for formation of peroxides. Peroxides are destroyed by heat and built up at room temperature. Storage of either unheated or once heated fats for 44 days resulted in comparable increases in peroxide concentration. However, each time a fat is heated it contains larger amounts of free fatty acids and carbonyl compounds which change only slightly during storage. For short periods of time approximately the same changes occur in fat stored either in a refrigerator or at room temperature.

The amount of chemical change taking place in the fat itself is inversely related to the volume of fat heated regardless of the type of fat or kind of frying pan used. The practice of maintaining a maximum volume of fat during frying is both a simple one for the homemaker and a good one, since the addition of fresh fat also dilutes the effect of chemical changes.

Two commonly held assumptions of homemakers are that use of vegetable oil and use of iron frying pans result in fried foods with better flavor. The experimental results obtained here provide some justification for these assumptions. Carbonyl compounds are flavor components of fats and of fried foods. Of all fats studied the vegetable oil contained the greatest amount of carbonyl compounds after heating. Of all the pans used iron resulted in the highest concentration of carbonyl compounds in the fat.

The use of metal pans results in higher amounts of carbonyl compounds in the fats after heating and the use of a glass ceramic pan results in higher amounts of peroxides and free fatty acids. Metal pans, particularly iron, exert a statistically significant catalytic effect on oxidation. Aside from a consideration of flavor, there seems little reason to choose one kind of frying pan or one type of fat in preference to any other since the differences between those studied, while statistically significant, were not large.

Regardless of the type of fat used, prolonged heating resulted in a considerably less unsaturated fat. If a particular type of fat is chosen for use because of its content of unsaturated fatty acids, the homemaker should bear in mind that each time a fat is re-used, it becomes less unsaturated. The change in unsaturation as well as the concomitant development of foaming in these fats make fat heated for as long as 50 hours extremely undesirable from a nutritional standpoint. However, use of such fats would be extremely unlikely because of their pronounced reddish-brown color development, their increased viscosity, and their severe foaming. These factors probably limit the practical heating life of a fat to between 10 and 20 hours.

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## GLOSSARY OF TECHNICAL TERMS

**AUTOXIDATION** — Spontaneous reaction of fat with atmospheric oxygen leading to rancidity, lack of palatability and undesirable flavors and odors.

**CARBONYL COMPOUNDS** — substances related to flavor. The amount and kind of these compounds present determine whether the fat will have a pleasant or a rancid odor and flavor.

**FATS** — substances made up of fatty acids in the form of triglyceride esters, usually solid or semi-solid at room temperature.

**FATTY ACIDS** — chemical compounds made up of long chains of carbon atoms with an acid group at one end of the chain.

**FREE FATTY ACIDS** — fatty acids liberated from the triglyceride ester structure. Their presence indicates some breakdown of the fat.

**ESSENTIAL FATTY ACIDS** — unsaturated fatty acids which cannot be manufactured by the body. These must be present in the diet for normal functioning of the body. There are three essential fatty acids — linoleic, linolenic, and arachidonic acids.

**HYDROGENATED FATS** — those which have been artificially hardened by the addition of extra hydrogen atoms to the unsaturated fatty acids present.

**IODINE NUMBERS** — chemical method for determining the degree of unsaturation of a fat.

**OILS** — the same as fats, except usually liquid at room temperature.

**PEROXIDES** — the first compounds formed during oxidation of fats. These can be harmful nutritionally as they may oxidize other nutrients (such as some vitamins) and prevent their utilization in the body. Heat destroys peroxides, so these compounds are more of a problem in stored food which is not reheated before use, than in freshly prepared fried food. Peroxides are precursors of such compounds as free fatty acids and carbonyl compounds.

**SATURATED FAT** — one whose component fatty acids contain the greatest possible amount of hydrogen. Fats may be saturated naturally, as many animal fats, or artificially by means of hydrogenation.

**UNSATURATED FAT** — one whose component fatty acids do not contain the greatest possible amount of hydrogen. Such fatty acids have "double-bonded" or unsaturated linkages between the carbon atoms. Unsaturated fatty acids are more susceptible to oxidation than saturated fatty acids. Large amounts of unsaturated fats are currently considered beneficial in the diet as agents for lowering blood cholesterol levels, and hence as protective agents against arteriosclerosis.

BULLETIN 642 APRIL 1962

# Use, Knowledge, and Attitudes Concerning Milk Products By Homemakers

By

Dorothy Dickins

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HENRY H. LEVECK, Director
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# USE, KNOWLEDGE, AND ATTITUDES CONCERNING MILK PRODUCTS BY HOMEMAKERS

By

Dorothy Dickins

## Introduction

Milk products are one of the four essential groups of foods needed for an adequate diet. Milk is a leading source of calcium essential for the development of bones and teeth and required for the proper functioning of muscles and nerves and for the normal clotting of blood. In addition, milk is an important contributor of riboflavin and high-quality protein, and provides many other vitamins and minerals as well as carbohydrates and fats. When fluid milk, or its equivalent in other forms of milk products, is omitted from the day's meals or used only in small amounts, calcium and sometimes riboflavin is likely to fall below amounts recommended.

It is the purpose of this study[1] to determine kinds and amounts of milk products used by representative urban families in Mississippi, adequacy of their consumption, and relationship of such consumption to knowledge and attitudes of homemakers concerning their use.

## Scope and Methods

This study included a representative sample of 808 families—517 white families and 291 Negro families residing in Meridian, Clarksdale, Picayune, and Winona. The 1960 Census shows population of the four cities to be 49,374; 21,105; 7,834; and 4,282, respectively.

Data were obtained during 1958 by personal interview with the use of a pretested schedule. The study was presented as a food rather than a milk products study. Questions pertaining to milk products were placed near the end of the schedule in order not to bias replies received.

## Description of Families

Only families in which at least one member had eaten one or more meals per day at home during the week preceding the interview were included. Institutional families (those with five or more boarders) and families of one person were not included. These families are relatively unimportant from the consumer market viewpoint. Income of the 517 white families during the year preceding the interview averaged $4,827; and that of the 291 Negro families, $1, 747. In this study income was defined as the sum of receipts from farm operation minus farm expenses; wages and salaries; non-farm business recipts minus business expenses; and all other non-farm income except non-recurrent income such as inheritances. Forty-six percent of the white families and 92 percent of the Negro families had per capita incomes of less than $1200 a year.

Estimating the size of the family by taking the total number of meals served from the home supply during the report week and dividing by 21 (the number of meals in one week), we found an average size for white families of 3.41 persons; for Negro families, 3.88 persons. Food costs per person per meal were less than

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[1] This is an analysis of some of the Mississippi data obtained in connection with the Southern Regional Marketing Study SM-13 Revised.

20 cents in 26 percent of the white families and in 67 percent of the Negro families.

Most white homemakers had high school training and most Negro homemakers elementary school training, as is shown:

| Last grade completed | White homemakers | Negro homemakers* |
|---|---|---|
| | Percent | Percent |
| 4 or less | 2 | 17 |
| 5 - 8 | 13 | 48 |
| 9 - 12 or business school | 63 | 29 |
| Some or all of college | 22 | 4 |

*Two percent gave no information.

Range of age of white and Negro homemakers was approximately the same. About one-half of the white and Negro women were under 40 years; about one-half 40 years or over.

## Kinds and Amounts of Dairy Products Used

During the report week 50 percent or more of both white and Negro families had used fresh fluid whole milk that had been pasteurized and homogenized as well as fortified with Vitamin D; American or yellow cheese; and ice cream (Table 1). Fifty percent or more of the Negro families had used in addition two other milk products; namely, non-fat dry milk and evaporated whole milk. Whole milk, both pasteurized and homogenized as well as fortified, was the only type of fresh fluid milk used to any extent, except for buttermilk which was used by nearly half of the white and Negro families. Some families used buttermilk in baking breads which is a food pattern passed on from parents. One of the interesting facts revealed from a study of Table 1 is the small variety of milk products used during the week by many families. In fact, use of milk products seems to be limited to a few of the better known products. One way to increase use would be to get the homemaker to try a greater variety of these products.

## Per Capita Consumption of Milk Products and Recommended Amounts

Milk products used by the family were converted into quarts of fluid milk equivalent which included not only fluid milk but the fluid milk equivalent of evaporated, condensed, and dry milk; cream; ice cream; and cheese, on the basis of the calcium content. Conversion factors developed by the Institute of Home Economics of the United States Department of Agriculture in 1958 were used to express the nutritive value of each product as compared with fluid whole milk.

Quantities of milk products for different family members in the moderate cost food plan developed by specialists of the United States Department of Agriculture were used in estimating milk needs for each family. The recommended dietary allowances of the National Research Council were used as the nutritional basis of the food plan.

Quantities of fluid milk equivalent per week suggested for various family members were: children 1-9 years, 6.0 qts.; children 10-12 years, 6.5 qts.; adolescents 13-20 years, 7.0 qts.; adults 21 years and over 3.5 qts.; and women lactating, 10.0 qts.[2]

No recommendations for children under a year were made by these specialists in the United States Department of Agriculture since most infants are fed according to the directions of a physician or nurse. Amounts fed vary with weight, growth, and the like. Therefore, in determining whether or not the family had milk in the quantities recommended, infants are treated separately.

The 517 white families included in this

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[2] Family Economics Review, Institute of Home Economics, A.R.S., USDA, Washington, D. C., October 1957, Table 3, page 9.

**Table 1.—Percentage of the 517 white and 291 Negro families using specified milk products in the home over a 7-day period, and average amount used by those using.**

| Product | Percentage using | | Quantity used by those using | |
|---|---|---|---|---|
| | White families | Negro families | White families | Negro families |
| FRESH FLUID MILK | | | | |
| Whole raw | 2 | 4 | 8 qts. | 9 qts. |
| Whole, past. creamline | 3 | 1 | 6 qts. | 4 qts. |
| Whole, past., homo. | 8 | 2 | 9 qts. | 3 qts. |
| Whole, past., homo., fortified | 85 | 69 | 10 qts. | 6 qts. |
| Skimmed, past. | 4 | 1 | 4 qts. | 6 qts. |
| Buttermilk | 43 | 44 | 2 qts. | 3 qts. |
| Choc. milk or drink | 8 | 5 | 3 qts. | 2 qts. |
| DRY MILK | | | | |
| Skim or non-fat | 38 | 61 | 14 oz. | 16 oz. |
| Whole | 0 | * | ---- | 5 oz. |
| Modified malt, hemo., formulas, etc. | 3 | 1 | 38 oz. | 15 oz. |
| CANNED MILK | | | | |
| Evap. whole | 39 | 60 | 32 oz. | 46 oz |
| Evap. skim | 1 | 6 | 51 oz. | 44 oz. |
| Condensed, sweetened | 7 | 3 | 18 oz. | 16 oz. |
| CREAM | | | | |
| Whipping | 9 | 3 | 2 ½-pts. | 2 ½-pts. |
| Coffee | 4 | * | 3 ½-pts. | 4 ½-pts. |
| Half & half | 8 | 2 | 2 pts. | 1 pt. |
| DRY CREAM | 1 | 0 | 5 oz. | ---- |
| CHEESE | | | | |
| American or yellow | 73 | 57 | 1 lb. | 1 lb. |
| Cottage | 16 | 7 | 1 pt. | 2 pt. |
| Cream | 6 | 2 | 6 oz. | 6 oz. |
| Spreads | 5 | 1 | 5 oz. | 5 oz. |
| Other (as blue, Swiss, pepper, etc.) | 5 | * | 7 oz. | 3 oz. |
| FROZEN PRODUCTS | | | | |
| Ice cream | 64 | 50 | 4 pts. | 3 pts. |
| Sherbet | 2 | * | 3 pts. | 1 pts. |
| Dairy cream | 1 | 1 | 2 pts | 2 pts. |
| Ice milk | 7 | 3 | 3 pts. | 3 pts. |

Note: There were other products on the schedule, but these are not shown in Table 1 since no family used them during the report week.

*Less than .5 percent.

study averaged 17.17 quarts of fluid milk equivalent during the week (or 5.04 quarts per capita). The 291 Negro families averaged 13.36 quarts of fluid milk equivalent during the study week (or 3.45 quarts per capita). The average recommended milk equivalent for white families was 4.35 quarts; for Negro families, 4.89 quarts. This means that the whites were getting, on the average, more than recommended amounts; the Negroes, less than recommended amounts. The important consideration is not average consumption but the percentage of families getting less than the recommended amount. These percentages were as follows:

| Percent of recommended amounts | White families | Negro families |
|---|---|---|
| | Percent | Percent |
| Less than 50 | 4 | 27 |
| 50 - 89 | 27 | 37 |
| 90 - 109 | 16 | 10 |
| 110 or more | 53 | 26 |

As will be noted, about two-thirds of the white families and one-third of the Negro families had 90 percent or more than recommended amounts of milk products.

Statistical analyses showed a highly significant relationship between size of household and recommended amounts of milk products received; also between cost per person per meal for food and recommended amounts of milk products received.[3] This was found in analyses of data from both white and Negro families. The relationship between recommended amounts of milk products received and income per capita was highly significant for Negro families but not significant for white families. Home background of the Negro homemaker (whether rural or urban South) was also highly significant. Also, there was some relationship between the use of recommended amounts and the age of the homemaker. Families with homemakers 50 years of age and over more often had recommended amounts.[4]

Many items that might show a relationship to use of recommended amounts of dairy products, such as size of household and expense per person per meal, are often highly inter-related. This cause-effect relationship can be recognized but not separated.

### Knowledge of Nutritive Value of Milk Products

Each homemaker was read the following six questions about nutritive value of foods: Do you think: (a) Orange juice is a good source of vitamin C; (b) Butter has more food value than oleomargarine; (c) Milk is a good source of protein; (d) Milk is a good source of calcium for strong bones and teeth; (e) Yellow cheese is a good food to use for variety in place of a meat dish; (f) milk is a good source of some of the B vitamins? To assist her in answering these questions she was given a card with four possible replies listed—yes, no, uncertain, don't know. The correct answer was "yes" to all questions except (b). The correct answer to (b) was "no". The question about vitamin C in orange juice was added since it was thought that this nutrition information was common knowledge due to extensive advertising by the citrus industry, and would therefore serve as a good check on data about nutritive value of milk products. The percentage of white and Negro women giving correct replies to the six questions was as follows

| Questions | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Orange juice a good source of vitamin C | 91 | 87 |
| Butter has more food value than oleo | 18 | 3 |
| Milk good source of protein | 86 | 86 |
| Milk good source of calcium | 99 | 95 |
| Yellow cheese good meat substitute | 86 | 81 |
| Milk good source of some of the B vitamins | 60 | 75 |

As will be noted, more white and Negro women thought milk a good source of calcium than thought orange juice a good source of vitamin C. However, the added phrase, "for strong bones and teeth", in regard to calcium may have affected replies.

Least known information by both groups concerned the nutritive value of butter versus oleomargarine. Butter, "the high-priced spread", no doubt has prestige that oleomargarine does not have. On the other hand, replies to the butter-oleo question may have been affected by the previous question, "Do you think orange juice is a good source of vitamin C?", for which the correct answer is "yes".[5]

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[3] Significant at the 1% level according to chi-square tests.

[4] Significant at the 5% level in white families and lacking just a fraction of being significant at the same level in Negro families.

[5] "No" was the correct answer to only one of the six questions used in the regional schedule. A study of the effect of the previous questions on replies could not be made since correct replies to all questions except one were "yes".

A relationship was found between replies to only two of the nutrition questions and recommended amounts of milk products received, both of these in the case of white families. The two questions were: Do you think yellow cheese is a good food to use for variety in place of a meat dish; and; do you think milk is a good source of protein?[6]

The low relationship between use of recommended amounts of milk products and possession of technical information about their nutritive value is in line with findings in studies made by home economists and sociologists concerning use and knowledge.[7] The findings of this study should not be interpreted to mean that knowing about nutritive value of milk products is not important. These findings should be interpreted to mean that there should be increased emphasis on techniques of getting the recommended amounts of dairy products into family diets, especially in diets of large families and families of low socio-economic status. This cannot be done by merely emphasizing the nutritive values which these products have.

## Use of and Attitudes About Cottage Cheese

Homemakers were asked if they thought cottage cheese was good for them. The replies of white and Negro homemakers to this question were as follows:

| Replies | White homemakers* | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Yes | 82 | 63 |
| No | 7 | 17 |
| Don't know | 10 | 20 |

*One percent gave no reply.

This means that one-third of the Negro and one-fifth of the white women either did not know whether or not cottage cheese was good for them, or thought it was not good for them.

Those who thought cottage cheese was good for them were asked why. Reasons given were:

| Reasons cottage cheese good for you | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Low in calories | 33 | 36 |
| A milk product | 34 | 33 |
| Easily digested | 11 | 9 |
| Protein content | 10 | 5 |
| Vitamin content | 4 | 7 |
| Doctor recommended | 3 | 4 |
| Calcium content | 4 | 1 |
| Other reasons | 1 | 5 |

Thirty-three percent of the white homemakers and 36 percent of the Negro homemakers thought cottage cheese was low in calories. Twenty-five percent of the white women were trying either to lose weight or to maintain the same weight. The percentage of Negro homemakers thus concerned about weight was 19. No relationship was found, however, between frequency of using cottage cheese and what was being done about weight. One factor may be the practice by distributors of adding heavy cream to cottage cheese. In many outlets only creamed cottage cheese is available.

Cottage cheese has been promoted as a food for the "reducer". As will be noted, however, more women gave other reasons why it was good for them. Perhaps in sales promotion more emphasis needs to be placed on other features of cottage cheese.

Low calorie content of cottage cheese

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[6] There was a significance at the 1% level between replies to the first question and use of recommended amounts of milk products. There was a significance at the 5% level between replies to the second question and use of these amounts.

[7] See (a) Knowledge of Nutrition as Related to the Use of Dairy Products, Dorothy Dickins and Virginia Ferguson. Journal of Home Economics, June 1958; (b) What the Homemaker Knows About Nutrition, C. M. Young. Journal of American Dietetic Assoc., March, April, May 1956; (c) The Home-Produced Food Supply of Non-Owner Farm Families, Dorothy Dickins. Miss. Agri. Exp. Sta. Bul. 512, March 1954; (d) Knowledge and Use of Recommended Farm Practices, H. H. Aurback, Miss. Agri. Exp. Sta. Information Sheet 540, June 1956.

with no cream added might well be stressed in programs directed towards older white women; and towards Negro homemakers with higher income per capita and more schooling who were more often found to be doing something about their weight.[8] More emphasis might well be given to production of more palatable low-calorie cottage cheese.

There was a close relationship between opinion as to whether cottage cheese was good for you and frequency of use.[9] Thirty-one percent of the white women who said it was good for you used it often; 5 percent who said it was not good for you used it often. These percentages for Negro women were 21 and 0 respectively (Table 2). Older white homemakers (50 years and over) with higher per capita incomes and more schooling more often said cottage cheese is good for you than younger homemakers with lower per capita incomes and less schooling. Negro homemakers with more schooling more often said cottage cheese is good for you than those with less schooling.

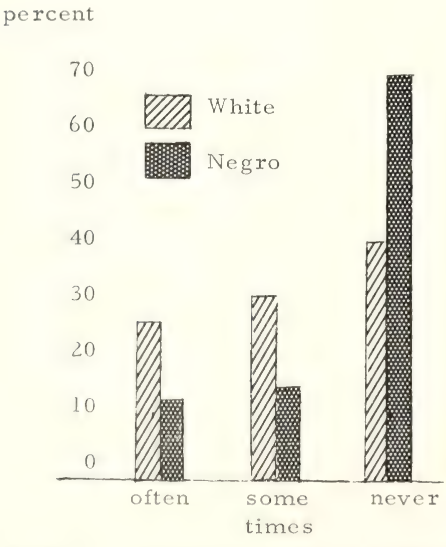

**Figure 1. Frequency of use of cottage cheese by white and Negro families.**

It is important that homemakers consider cottage cheese to be good for them, since this opinion is associated with greater use. In educational programs with homemakers of limited schooling more attention might be given cottage cheese, its food value, and it uses.

### Beverages for the "Reducer"

The following statement was read to homemakers: A grown person is being careful about eating **in order to lose a little weight.** This person has a light breakfast and a moderate evening meal. If a lettuce and tomato sandwich is selected for lunch, what drink would you suggest with it?

The following drinks were suggested by white and Negro homemakers.

| Drink | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Milk, skim or non-fat dry | 25 | 23 |
| Milk, whole or flavored | 23 | 15 |
| Tea | 21 | 8 |
| Fruit, vegetable juices | 4 | 22* |
| Coffee | 13 | 5 |
| Soft drinks | 3 | 7 |
| Buttermilk | 3 | 4 |
| Powdered drink | 0 | 1 |
| Other, none, or don't know | 8 | 15 |

*In a study of "Collection Methods in Dietary Surveys', Southern Cooperative Series, Bul. 23, April 1952, it was suggested that oranges are a prestige food with Negroes and consumption therefore more likely to be overestimated. This may apply to juices since orange juice is one of the most common juices.

The principal reason for suggesting milk (skim, or non-fat dry), tea, fruit

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[8] Significant at the 1% level according to chi-square test for what was being done about weight by Negro women and education, and at 5% level for what was being done about weight by white women and age, and at the same level for what was being done about weight by Negro women and income per capita.

[9] Significant at the 1% level for both whites and Negroes.

**Table 2.—Relationship of attitudes towards cottage cheese and frequency of use.**

| Race and frequency of use | Whether cottage cheese is good for you | | | Total No. |
|---|---|---|---|---|
| | Yes | No | Don't know | |
| | Percent | Percent | Percent | |
| WHITE FAMILIES | | | | |
| Often* | 31 | 5 | 8 | 138 |
| Sometimes | 34 | 33 | 16 | 165 |
| Never | 35 | 62 | 76 | 210 |
| Total No. | 426 | 37 | 50 | 513** |
| NEGRO FAMILIES | | | | |
| Often* | 21 | 0 | 3 | 40 |
| Sometimes | 22 | 10 | 3 | 47 |
| Never | 57 | 90 | 93 | 202 |
| Total No. | 180 | 50 | 59 | 289** |

*Means once a week or more often.

**Several gave no replies as to frequency of use.

or vegetable juices, coffee, soft drinks, buttermilk, and powdered drinks was "few calories". The calories contained in one cup of these beverages are as follows:

| Beverages | Calories |
|---|---|
| Whole milk | 166 |
| Non-fat (skim) milk | 87 |
| Buttermilk | 87 |
| Carbonated beverages | 107 |
| Orange juice (canned unsweetened) | 109 |

Tea and coffee would have no calories unless sugar, milk, or other ingredients with calories were added. Powdered drinks can be purchased with or without sugar; but when purchased unsweetened, directions are for 1-1½ cups of sugar to two quarts of water. The main reason for suggesting whole or flavored milk was "nourishing" (including "healthful", "has protein").

These two reasons, "few calories" and "nourishing", accounted for about 90 percent of those given for choice of a specified drink with a lettuce and tomato sandwich, as is shown:

| Reason | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Few calories | 64 | 68 |
| Nourishing | 29 | 21 |

No relationship was found between what the women were doing about their own weight and the beverage they choose to drink with the tomato sandwich.

A relationship was found, however, between the usual beverage of both white and Negro homemakers at noon in cold weather and the beverage they suggested with the lettuce and tomato sandwich.[10] Such a relationship was not found between the usual beverage of homemakers at noon in warm weather and their choice of a beverage with the sandwich. This difference is related to the fact that about one-half of the women chose a milk drink with the lettuce and tomato sandwich, and that milk was the usual drink of both white and Negro women much more often in cold than in warm weather.

If the homemaker did not suggest some type of milk drink with lettuce and tomato sandwich she was asked what she thought of having milk with this sandwich. The percentages of white and Negro homemakers classified by thoughts about having milk were as follows:

| What homemakers thought of having milk | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Would add calories, too fattening | 39 | 48 |
| O.K., if skim or buttermilk | 36 | 28 |
| O.K., if she likes it | 13 | 17 |
| Wouldn't go with sandwich | 5 | 4 |
| Nourishing, healthful | 5 | 2 |

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[10] For whites the relationship was significant at the 1% level, and for Negroes at the 5% level, according to chi-square tests.

From the replies it would seem that about three-fourths of the white and Negro women think of whole milk as a fattening food. A comparison of the calorie content of whole milk with some other foods rich in protein shows the fallacy of this idea. The calorie content of some common units of such foods is, for example:

| Food and unit | Calorie content |
|---|---|
| 1 cup whole milk | 166 |
| 3 oz. hamburger | 316 |
| 1 cup beef and vegetable stew | 252 |
| 1 medium pork chop | 292 |
| 2 oz. boiled ham | 172 |
| 3 oz. beef rib roast | 266 |

### Beverages and Eating Out

Homemakers were asked: "Do you sometimes eat at a restaurant, cafeteria, or other place like that?" Only 43 percent of the white homemakers and 11 percent of the Negro homemakers replied yes. Those who ate "out" were asked what they usually had to drink in cold and warm weather with four types of orders: (1) a plate lunch with pork chops, (2) a hamburger, (3) a roast beef sandwich and (4) a fish plate. Pictures of these were shown each interviewee.

The percentages of total drinks mentioned by white and Negro homemakers in connection with these four lunches were as follows:

| Drink* | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Coffee | 38 | 25 |
| Soft drink | 22 | 36 |
| Tea | 32 | 21 |
| Milk (all kinds) | 7 | 15 |

*Does not add up to 100% since a few mentioned juices and powdered drinks.

Coffee was named by more white homemakers; soft drinks by more Negro homemakers. Milk ranked fourth in both groups. As will be noted in Table 3, more white and Negro women named milk in connection with the roast beef sandwich and the plate lunch. Few named milk in connection with the fish plate. There is a folk rule with which many are familiar, "Never eat fish and milk together", which may be related to the fact that few chose milk with the fish plate.

Homemakers were asked why they selected that particular beverage with that lunch for that season. The three most common reasons given in connection with all beverages named by both white and Negro homemakers were:

| Reasons* | White homemakers | Negro homemakers |
|---|---|---|
| | Percent | Percent |
| Go together | 42 | 28 |
| Like taste, prefer, habit, fills you up | 27 | 20 |
| Warm/cold weather drink | 16 | 29 |

*Does not add up to 100% for reasons given by relatively few are not listed.

The reason most often given for choice of milk with the four lunches was "they go together". This was also the most important reason for choice of a soft drink with the lunch. "Like taste, prefer, habit" was the reason most often given for the selection of tea with the lunch. The reason most frequently given for choosing coffee was, "It's a warm/cold weather drink". "They go together" was also mentioned often as a reason for choice of coffee and tea.

What is it that makes people think that certain lunches go with milk and certain lunches go with soft drinks? An answer to this question is important information for the milk industry as well as other industries. Do certain foods actually taste better together, or is it a matter of training, habit, or other factors? This whole area is in need of much research effort.

### Beverages and the Teen-Ager

The following statement was read to interviewees: A teen-ager I know likes milk but drinks cokes most of the time. Why do you think she does that? The percentage of white and Negro homemakers giving specified replies was as follows:

| **Reason*** | **White homemakers** | **Negro homemakers** |
|---|---|---|
| | Percent | Percent |
| To be with the crowd | 30 | 17 |
| Likes taste of cokes | 15 | 24 |
| Habit, custom, fad | 16 | 15 |
| Cokes not fattening | 10 | 10 |
| Cokes easier to get, cheaper | 9 | 8 |
| To be grown up | 7 | 8 |
| Cokes give energy, pep | 6 | 6 |
| Parents allow, keep cokes on hand | 1 | 1 |

*Does not add up to 100% for replies of "don't know" and "no reply" are not included.

Reasons given by women with different educational and home backgrounds were studied. A highly significant relationship was found between the reasons given by white and Negro homemakers and schooling. The women with more schooling (both white and Negro) more often gave "to be with the crowd" as a reason than did the women with less schooling. On the other hand, the women with less schooling more often replied, "likes taste of cokes" than did the one with more schooling. No relationship was found between home background and the reason she thought teen-agers drank cokes when they liked milk.

Homemakers were asked not only about why the teen-agers would drink cokes most of the time, but also about what they would say to encourage them to drink more milk. The comments homemakers would make to teen-agers to get them to drink more milk were:

| **Comment*** | **White homemakers** | **Negro homemakers** |
|---|---|---|
| | Percent | Percent |
| Milk is healthful | 50 | 62 |
| Insist she drink milk | 5 | 12 |
| Cokes not good for you | 8 | 8 |
| Milk good for bones and teeth | 10 | 5 |
| Add syrup, malt; keep milk on hand | 9 | 4 |
| Milk good for complexion | 7 | 1 |
| Milk not fattening | 1 | 1 |
| Don't follow crowd; have mind of your own | 1 | 1 |

*Does not add up to 100% since it does not include replies of "don't know" and "no reply".

**Table 3.—Beverages white and Negro homemakers report they usually have in cold and warm weather with four types of lunches.***

| Lunch and beverage | White homemakers | | Negro homemakers | |
|---|---|---|---|---|
| | Cold weather | Warm weather | Cold weather | Warm weather |
| | Percent | Percent | Percent | Percent |
| PLATE LUNCH (pork chops) | | | | |
| Coffee | 67 | 17 | 53 | 3 |
| Tea | 19 | 76 | 7 | 55 |
| Milk (all types) | 12 | 3 | 30 | 10 |
| Soft drinks | 2 | 4 | 10 | 29 |
| HAMBURGER | | | | |
| Coffee | 42 | 11 | 29 | 3 |
| Tea | 4 | 14 | 6 | 7 |
| Milk (all types) | 6 | 4 | 13 | 3 |
| Soft drinks | 47 | 71 | 52 | 87 |
| ROAST BEEF SANDWICH | | | | |
| Coffee | 56 | 13 | 42 | 10 |
| Tea | 13 | 43 | 16 | 28 |
| Milk (all kinds) | 15 | 15 | 19 | 24 |
| Soft drinks | 16 | 28 | 23 | 35 |
| FISH PLATE | | | | |
| Coffee | 68 | 29 | 45 | 18 |
| Tea | 25 | 61 | 10 | 39 |
| Milk (all types) | 2 | 2 | 10 | 0 |
| Soft drinks | 5 | 6 | 24 | 27 |

*Juices and powdered drinks were not tabulated because there were so few cases.

The comments made by white home makers were related to their age and schooling. No relation was found in comments of Negro homemakers and these two factors.

White homemakers with more schooling more often mentioned "add syrup, malt; keep on hand" and "milk good for complexion" than did those with less schooling. On the other hand, those with less schooling more often mentioned "milk is healthful" and "insist she drink milk" than did those with more schooling.

More younger than older women mentioned "milk good for complexion" and "add syrup, malt; keep on hand". More older women than younger women said "tell them it's healthful". Perhaps "healthful" has been mentioned too often in connection with milk while "looks, appearance, and popularity" have been mentioned too seldom.

## Beverages to Serve Adult Friends at Dinner

All interviewees were asked: In cold/warm weather when you have adult friends to dinner (at home) what drink do you usually serve? As will be noted in Table 4, most homemakers, both white and Negro, said they served coffee to adult friends at dinner in cold weather and tea in warm weather. Homemakers were not asked whether or not it was hot or iced tea. nor whether the coffee was hot or iced. This question was not necessary since it is common knowledge that the coffee usually served in Mississippi is hot; the tea iced.

The most important factors in what was served to adult friends in warm and cold weather seemed to be the homemaker's usual beverage at dinner and the husband's usual beverage at dinner. In other words, adult friends were served the beverage which the homemaker and her husband generally had at this meal and season.[11]

After the homemaker told what drink she usually served adult friends at dinner she was asked whether she offered milk to these adult friends. The following percentages of white and Negro women reported they offered it most of the time, sometimes, or never:

| **Frequency of offering** | **White homemakers** | **Negro homemakers** |
|---|---|---|
| | Percent | Percent |
| Most of the time | 34 | 25 |
| Sometimes | 27 | 22 |
| Never | 39 | 53 |

Table 4.—**Drink usually served in cold and in warm weather when homemaker has adult friends to dinner at home.**

| Drink | Cold weather | | Warm weather | |
|---|---|---|---|---|
| | White homemaker | Negro homemaker | White homemaker | Negro homemaker |
| | Percent | Percent | Percent | Percent |
| Coffee | 88 | 65 | 9 | 5 |
| Tea | 7 | 12 | 85 | 60 |
| Milk | 3 | 3 | 1 | 1 |
| Flavored milk | 1 | 5 | 0 | 0 |
| Buttermilk | * | 0 | 0 | * |
| Fruit and vegetable juices | 0 | 1 | * | 7 |
| Powdered drink | 0 | 2 | 1 | 8 |
| Soft drink | 0 | 3 | 3 | 10 |
| Other, none, don't know | 1 | 9 | 1 | 9 |

*Less than .5 percent.

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[11] According to chi-square tests the relationship between what was served at the evening meal to adult guests in both white and Negro families in both warm and cold weather and the usual beverage at the evening meal of both husband and wife in white and Negro families in cold and warm weather was significant at the 1% level.

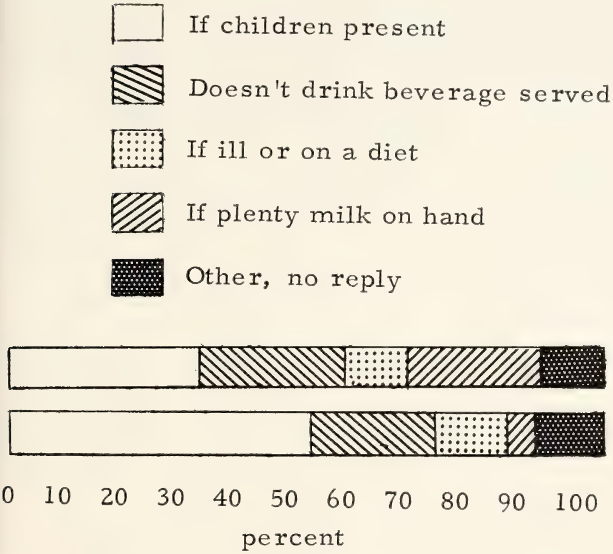

**Figure 2. Conditions which lead homemakers to sometimes offer milk at dinner to adult friends.**

Those women who replied "sometimes" were asked under what conditions they offered it. Figure 2 shows these conditions. The most frequent of these is when children are present. The children are offered milk and in doing this the polite thing seemed to be to ask adults if they would not like some also, especially if the number of adults is small.

Another condition under which milk is offered is when the adult friend does not drink the beverage served. Also, milk is offered adult friends when it is known they are not well, or on a diet. One-fifth of the Negro women mentioned offering milk when plenty was on hand.

All interviewees were asked why they thought some families did not offer milk to adults. Replies given were as follows:

| Why I don't offer milk | White homemaker | Negro homemaker |
|---|---|---|
| | Percent | Percent |
| Milk is for a child; adults like stimulating drink | 45 | 38 |
| Would not have milk on hand | 13 | 25 |
| Too expensive | 15 | 18 |
| Never drink milk themselves so don't think of it | 15 | 10 |
| Social custom not to drink milk at company meals | 4 | 2 |
| Other | 2 | 1 |
| Don't know | 6 | 6 |

Underlying all these reasons for not offering milk to adult friends are two basic one: (1) Milk is children's food. If there are no children in the household there may not be any milk on hand.

(2) Milk is expensive. Neither of these two reasons are accurate. Milk is a food, not just a drink. It is a food needed by adults as well as by children. Milk is not an expensive food. In fact, considering nutrients one gets from milk, it is one of the cheapest foods.

### Summary and Implications

The purpose of this particular study was to determine use, attitudes, and knowledge concerning milk products by Mississippi urban homemakers. Data from 517 white and 291 Negro urban families of Mississippi are included. Income of white families averaged $4,827; and that of Negro families, $1,747. Average family size of white families was 3.41 persons; of Negro families, 3.88.

The 517 white families consumed an average of 17.17 quarts of fluid milk equivalent during the report week (or 5.04 quarts per capita). The 291 Negro families consumed 13.36 quarts of fluid milk equivalent during the study week (or 3.45 quarts per capita). The average recommended milk equivalent per capita for white families was 4.35 quarts; for Negro families, 4.89 quarts. Thirty-one percent of the white families and 64 percent of the Negro families had less than 90 percent of the recommended amount of dairy products for families of their size and composition. Small families, families spending more per person per meal, and families with homemaker 50 years of age and over more often used milk products in recommended amounts.

The percentage of homemakers giving correct replies to five statements about the nutritive value of dairy products was high except for the statement concerning food value of butter as compared with oleomargarine.

Little relationship was found between ability to answer technical questions about nutritive value of milk products and use of recommended amounts of these products.

One-third of the Negro women and one-fifth of the white women either did not know whether or not cottage cheese was good for them, or thought it was not good for them. No relationship was found between frequency of using cottage cheese and what was being done about weight. However, there was a close relationship between opinion as to whether cottage cheese was good for you and frequency of use. Women, both white and Negro, with more schooling more often thought cottage cheese was good for them.

When asked to select a drink to serve with a tomato sandwich to a person trying to lose a little weight and what she thought of having milk with it, it was found that about three-fourths of the white and Negro women think of whole milk as a fattening food.

When asked to name the beverage she would order when eating at a restaurant, cafe, etc., with four types of lunches, milk ranked fourth by both white and Negro homemakers. The reason most often given for choice of milk with the four lunches was "they go together".

When asked why teen-agers who liked milk would drink cokes most of the time, homemakers with more schooling more often mentioned "to be with the crowd"; those with less schooling, "likes taste of cokes".

When asked what they usually served to adult friends at dinner in cold and warm weather most homemakers named the beverage she or her husband usually drank at this meal, which was coffee in cold weather and tea in warm weather. The principal reasons given for some homemakers not offering milk was that it was regarded as children's food and that adults like a stimulating drink.

Some of the implications of this study for producers, processors, retailers, and educators are:

(1) Large families and families spending small amounts per person per meal need assistance in ways and means of

getting more milk products into family meals.

(2) Opportunities should be provided for tasting and learning to like the great variety of milk products on the market.

(3) There needs to be increased emphasis on techniques of getting the recommended amounts of dairy products into family diets. This cannot be done by merely emphasizing the nutritive values (protein, calcium, vitamin B value) which these products have.

(4) Sales promotion of cottage cheese should have a slogan other than "weight reduction". "It's good for you" is the type of information that leads to greater use by the average family.

(5) Programs on use of low-calorie dairy products (such as cottage cheese with no cream, fresh skim milk, evaporated skim milk, non-fat dry milk) might be centered on the older white homemakers and Negro homemakers with more schooling, since members of these groups are more frequently reducing or trying to maintain the same weight.

(6) The fact that whole milk is not a "fattening" food needs to be continually stressed in educational and promotional programs.

(7) An effort needs to be made to determine why there is a feeling that some foods go with milk, others do not. What are these foods that go with milk?

(8) It would seem that many homemakers are using the wrong psychology with teen-agers in getting them to take more milk. What are the best appeals? Athletic skill, good complexion, beauty, glamour? Have these appeals had a fair trial? Why are milk shakes so popular with the teen-agers? Is it because of flavor; or because of price prestige (they sell for 25c or more).

(9) Why is milk thought of as children's food rather than food for all people? Has too little emphasis been given to the fact that adults might have a stimulating drink, such as coffee or tea, as well as the food, milk. It need not be either/or, but both.

(10) Programs should show that milk is not expensive; they should also demonstrate uses of some of the cheaper forms of such products.

BULLETIN 643 APRIL 1962

# Watermelon Hybrids

Two watermelon fruits grown in the greenhouse, weighing 22 and 23 pounds each. The seed of one of these melons is sufficient to raise over five hundred transplants, more than enough to plant one acre of watermelons.

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
STATE COLLEGE MISSISSIPPI

MITCHELL [illegible]RIAL LIBRARY

## The Marks of a Perfect Watermelon

**P**roductive and vigorous

**E**arly

**R**esistant to diseases, insects, drought, and sunburn

**F**orm and size to meet trade requirements

**E**ating qualities—sweet crisp and tender

**C**olor of rind and flesh according to preference

**T**ough rind, hard, thin, and flexible

# WATERMELON HYBRIDS

By S. S. IVANOFF and R. C. ALBRITTON*

The use of first generation hybrids of watermelons for commercial purposes is practically unknown. Probably the chief reason for this is the high cost of seed production, combined with the relatively large amounts of seed ordinarily required to plant, **and often replant,** a field of watermelons. Perhaps still another reason is that not enough attention has been devoted to studying the various hybrid combinations and their advantages for commercial use.

Hybrid seed has been occasionally offered for sale to home gardeners in limited amounts and at high prices. Hybrids have been produced by plant breeders as a part of breeding new varieties and in order to study the manner of inheritance of various plant and fruit characteristics. (1,2,4,8,9,11,12).

The difficulty of seed requirements has been indirectly met to considerable extent by successfully growing transplants in perishable pots as reported earlier (3). With the use of such transplants not more than 500 seeds are needed to plant an acre, which is less than the number usually found in a single average-size watermelon.

The use of hybrids offers many possible advantages:

1 Production in one generation of a great variety of fixed fruit types in respect to shape, size, rind, flesh, eating, and other qualities.

2. Making use of the fact that many valuable characteristics are inherited in a dominant manner in the first generation, such as resistance to some diseases, toughness of rind, and other internal traits — this saves years of breeding work.

3. Assuring high uniformity of marketable melons, in appearance and time of harvesting.

4. Possibilities of producing early maturing types, earlier than either parent, as some observations have indicated. This refers to a type of heterosis which is not correlated with size of plant or vigor of growth.

5. Although oridinarily not exhibiting apparent hybrid vigor, watermelon hybrids in some tests seemed to show that they are better able to set fruit under drought conditions than the parents from which they originated.

### What Kind of Parents Make the Best Hybrids?

There is considerable work yet to be done to find out what are the combining abilities of each of the various kinds of watermelons for making hybrids, and what kind of hybrid may be produced by crossing any two commercial kinds, particularly in regard to yields, earliness, and eating qualities. As far as our knowledge goes now the hybrid types may be predicted only in part. Much testing work is needed, as has been done and is being done with corn hybrids, to decide on the most desirable combinations. Perhaps it would be preferable to employ inbred parents of high homozygosity. Different hybrids may meet different purposes, needs, and tastes and a large number would have to be made from which to select the desired kinds. Numerous and interesting variations may be produced with relatively few parents. For instance, with 10 different parents it is possible to make as many as 45 different crosses, not counting reciprocals; with 20 parents, 190 combinations; and with 30 parents, 435 different hybrids may be produced.

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*The authors gratefully acknowledge the cooperation and valuable asisstance of Howard D. McMorrough, Assistant County Agent, Monroe County, in connection with the 1961 trial at Aberdeen, Mississippi.

### Inheritance Tests

Attention was given to a critical reinvestigation of the inheritance of some important characteristics such as resistance to anthracnose, toughness of rind, and color of flesh.

Resistance to anthracnose was studied with 11 particular hybrids, produced in the greenhouse by crossing in various ways 10 different varieties and selected Mississippi inbreds. The resistance of the parents and the crosses was measured by a reliable greenhouse technique previously used by another investigator (6). It was established that some of the parent varieties or strains had a high degree of resistance, others were susceptible, while still others were intermediate in that respect. Parents and crosses were tested at the same time and it was found that resistant × resistant parent gave a resistant hybrid; resistant × intermediate, produced a resistant hybrid; resistant × susceptible also gave a resistant hybrid.

In all of the hybrids resistance was inherited in what seemed to be completely dominant manner, as has been found out earlier in the case with other hybrids (6). It did not matter whether the resistant parent was the male or the female. Only susceptible × susceptible parent gave a susceptible hybrid as expected. The detailed results of these tests are shown in Table 1.

Resistance to fusarium wilt and its expression in the first generation hybrid is somewhat complicated. Resistance derived from certain citrons seems to be inherited as a recessive character. Resistance derived from other sources is reported to behave in a different manner (1, 9, 12). After weighing all the evidence presented by different investigators it appears that given a highly resistant parent carrying more than one genetic factor for resistance, gathered from diverse sources, the chances are that an intermediate to dominant expression would be the result in the hybrid.

Toughness of rind is very important in shipping. It is the ability of the melon to resist force without breaking. Previous work has shown that toughness is inherited in a dominant manner (8). In our own studies, two component qualities which make toughness have been genetically differentiated, namely, firm or hard texture on one hand and flexibility or resiliency on the other. These were found to be inherited independently of each other (2). Each seemed to be governed by a different gene or sets of genes, one relating to the firm, compact, solid, **but brittle,** tissue, the other to that quality of the rind which enables it to rebound or spring back intact after pressure has been applied to it.

When a melon with a tough rind was crossed with one that had a soft and

**Table 1.—Reaction of watermelon hybrids to anthracnose as determined by the resistance of the two parents. (Results determined by artificial inoculations in the greenhouse.)**

| Parents (female x male) | Parents' degree of resistance to anthracnose | First generation (F-1) hybrid's resistance to anthracnose |
|---|---|---|
| Fairflax x Spaulding | resistant x resistant | resistant |
| Fairfax x Miss. 1800 | resistant x intermediate | resistant |
| Congo x Miss. 1800 | resistant x intermediate | resistant |
| Spaulding x Cobb Gem | resistant x very susceptible | resistant |
| Charleston Gray x Shipper | resistant x susceptible | resistant |
| Miss. S25-2-24 x Shipper | resistant x susceptible | resistant |
| Cobb Gem x Charleston Gray | very susceptible x resistant | resistant |
| Criss-Cross x Charleston Gray | susceptible x resistant | resistant |
| Desert King x Charleston Gray | susceptible x resistant | resistant |
| Desert King x Spaulding | susceptible x resistant | resistant |
| Cobb Gem x Shipper | very susceptible x susceptible | susceptible |

inflexible rind, the resulting hybrid had a tough rind. Subsequent hybrid generations showed that hardness and flexibility are not only two distinct traits, inherited independently of each other, but that each is inherited in a dominant manner. This fact provides another inducement for using hybrids for commercial purposes, because it may enable the seedsman to produce, in only one season, a new fixed shipping type with select epicurean features by crossing a tough-rind melon with one of the non-shipping "old fashioned" home garden favorites.

The inheritance of color of the flesh is of practical importance because of consumer preferences. It has been reported that red color is dominant over yellow (8,11). In our studies crosses were made between a yellow-meated type melon on one hand, and several red-meated melons of different red intensities on the other. The resulting hybrids all had red color. However, there was a question of interpretation, whether the red color was completely dominant over yellow. Perhaps of some significance was the observation that when melons of deep yellow color were crossed with melons of deep crimson, a very attractive brilliant red color was produced, suggesting a color synthesis, or a degree of incomplete dominance. This may be of practical importance because by choosing the color intensities of the parents, new and varied hues and nuances of red colors, to enhance consumer appeal, may be created.

Although the great majority of buyers prefer melons with red flesh, the yellow meated varieties are of interest to the breeder and hybrid seed producer because they possess valuable traits in regard to meat tenderness and particularly to drought resistance. Such characteristics become valuable when they are inherited in a dominant or even intermediate manner.

## Yield Tests

Eight selected Mississippi hybrids were tested in 3 locations in the State in replicated trials, comprising a total of 8 replications of 5 plants each. The purpose of these trials was chiefly to seek an indication of the yield potentialities of the various hybrid combinations for commercial use. Transplants were raised in the greenhouse in sterilized soil in 3-inch perishable "Ferto" pots commercially produced from pressed cow manure. The yield results from these tests are presented in Table 2. They show variations in the yield of the different hybrids, but above all they seem to indicate that very high yields are possible with certain hybrids when handled in the manner described.

The highest yield of 33.5 tons per acre of good quality marketable melons with an average weight of 30.3 lbs. was produced at the Northeast Mississippi Branch Experiment Station at Verona, Missis-

**Table 2.—Marketable yields of watermelon hybrids in tons/A grown from transplants at 3 locations in Mississippi in 1961.***

| Designation | Female x male parent | Aberdeen | State College | Verona | Average |
|---|---|---|---|---|---|
| 1 | Spaulding x Cobb Gem | 13.6 | 22.5 | 33.5 | 23.3 |
| 2 | Cobb Gem x Charleston Gray | 15.8 | 17.5 | 20.9 | 18.0 |
| 3 | Fairfax x Spaulding | 16.9 | 12.3 | 14.4 | 14.5 |
| 4 | Fairfax x Miss. 1800 | 15.3 | 20.1 | 28.5 | 21.3 |
| 5 | Desert King x Charleston Gray | ------ | ------ | 17.9 | ------ |
| 6 | Charleston Gray x Shipper | 9.3 | 23.6 | 16.2 | 16.3 |
| 7 | Congo x Miss. 1800 | 19.5 | 20.5 | 22.0 | 20.6 |
| 8 | Miss. S25-22 x Shipper | ------ | 20.0 | 30.2 | ------ |

*Melons 20 lbs. and over, without apparent defects, were considered marketable.

sippi, by the hybrid, Spaulding × Cobb Gem. This is a cross between one of the smallest-fruit variety with one of the largest-fruit variety available. The average yield for all the hybrids tested at that location was 22.8 tons per acre. which is considered above normal. At the two other localities, Aberdeen and State College, the average yields, with a somewhat different set-up, were 15.0 and 19.5 tons per acre, respectively. Lack of space prevented a direct comparison between the hybrids and their respective parents. In previous trials with individual hybrids, however, it was established that hybrids yielded as much or more than either parent.

### Some Practical Considerations

Many observational tests were made to study the performance of various hybrids. From these tests some deductions may be summarized which may be of interest to future hybrid seed growers to serve as a practical guide in making hybrid combinations.

1. In trying to achieve higher productivity and higher sugar content in a hybrid, the best results may come from crosses involving a large-size melon variety with small-size, but prolific, variety or inbred. The hybrid fruit would be expected to be intermediate in size.

2. Usually there was a correlation between small fruit size and number of fruits produced in a variety or hybrid, this being generally observed in other species of fruits and vegetables. Likewise a correlation has been noted between short internodes on one hand and small fruit size, large number of fruits, larger number of leaves and smallness of leaves, on the other. When such small-fruited, prolific types are encountered in the breeding work, it may be best not to discard all of them because they could be useful in making certain desirable hybrid combinations.

3. The observation that some hybrids mature earlier than either parent is an interesting one. It deserves further study because it would be of obvious practical significance since earliness and high prices often go together. This phenomenon was first observed in a cantaloupe hybrid. It is more evident and more easily observed in this crop because the ripening process may be followed with much greater degree of accuracy than in watermelons.

4. To produce an abundance of hybrid seed, the female parent of the cross should be a good seed producer and should be given as much opportunity to grow to size and maturity as possible. However, the hybrid fruit (containing the second generation seed) would also likely be a good seed producer.

5. The use of sterilized soil for raising transplants is recommended. A simple and practical method for sterlizing small quantities of soil has been described (5).

### The Economics of Hybrid Seed Production

At present, it seems relatively expensive to produce first generation hybrid seed of watermelons by hand pollination. The road to efficiency and success lies most likely through the use of cytoplasmic male-sterile parents, genetic markers, or by male sterility artificially induced by chemical or other means (7, 10). Until such methods become a practice in commercial seed production, hybrid seed will remain relatively expensive.

Yet the watermelon crop has one very unusual advantage other vegetables do not have which has a bearing on the seed economy, namely, it takes less than 500 plants to fill an acre, if planted at the usual spacing of 10' x 10'. Under present practice, however, many times more seed are needed to plant an acre because difficulties often exist in getting a stand with seed directly planted in the field. Watermelon seed is very susceptible to rotting, by dry rots, wet rots, and damping-off, even when the seed has been treated with fungicides. Low temperatures also delay and interrupt germination, which weakens the seed. Replanting adds to the expense. but what is even more important, it eventually delays the harvest, and the grower misses the good prices for early melons. This is the reason many find it necessary to plant ten or more seeds per hill, and more hills than needed, with the hope of getting a satisfactory stand.

All these difficulties of getting a good stand with economy of seed may be avoided if transplants are used, since in raising transplants only one seed per pot is planted. It is by way of transplants that planting of hybrids may seem feasible at present. The seeds produced within a single average size watermelon by hand-pollination would be sufficient to plant an entire acre with transplants.

Perhaps it will be by transplants that hybrids of other crops, such as cotton—with all the benefits they offer—will eventually be introduced to cultivation.

First generation hybrid seed was produced in the greenhouse by growing the vines in benches or in crocks. Contrary to general belief, good size watermelons may be raised in greenhouses, averaging up to 20 pounds and yielding 600 seeds or more. On some occasions twenty-five

**Many inbred and hybrid fruits growing in crocks in the greenhouse. They are made by controlled hand pollination. Each small fruit may contain from 25 to 150 seeds. Photo made in Experiment Station pathology greenhouse at State College, Miss.**

**Two watermelon transplants 3 and 5 weeks old in perishable pots. The pots disintegrate soon after transplanting.**

pound fruits have been produced in the greenhouse, but in most cases fruits raised in crocks have been small. On a greenhouse bench area of about 130 square feet, approximately 6,000 seeds from about 30 watermelons were obtained. Planting was made in late fall and the fruit harvested continuously through early spring. This seed was sufficient to plant 12 acres with transplants.

On the other hand, hand pollination of seed may be carried out in the field under ordinary growing conditions with much greater success, and less expense to the producer. A field-grown mature fruit of 30 or 40 lbs. may contain approximately 800 to over 1,000 seeds, weighing about 3 to 3-½ oz. Technically, the production of hybrid seed by hand is not too difficult. The time consumed in making a cross may be counted in seconds, and the number of "takes" is quite large, very often nearly 50 percent of the attempts made. (In contrast, the making of crosses with cantaloupes is much less successful, usually averaging 5 percent of "takes", sometimes even less.)

Eventually, with improved methods it may be found that even by hand pollination, production of hybrid seed will not be too uneconomical.

### How to Produce Hybrid Seed in the Field

Each watermelon vine produces two distinct kinds of flowers, male and female. There are many more male flowers than female on each plant. The differences between male and female flowers are easily learned. The male flowers produce the pollen grains which contain the male generative cells. The female flowers are larger and each carries an ovary that terminates above in a 3-lobed stigma. The stigma is the receptive area of the pollen.

Occasionally female flowers, which also carry vestiges of pollen sacks have been encountered in the common varieties. Such flowers should be avoided when making hand pollinations. A few uncommon varieties are definitely hermaphroditic—they have both the fully developed male and female organs on the same flower.

Hybrid seed may be produced in the following manner.

**First Step:** Start when vines have just begun to set fruit naturally. In late afternoon female blossom buds of one of the parents are covered with paper cups (small ice-cream cups will do) which are fastened to the ground by a stiff wire to keep them in place. Female buds with large ovaries on vigorous runners are the best. These buds will open early the following morning. The cups protect the bossoms from being visited and chance-pollinated by bees and other insects. Male buds of the other parent are likewise covered.

**Second Step:** The following morning, starting as early as possible, the male blossoms under the cup are gathered and placed in a small covered container and carried along. The female blossoms are now uncovered one by one and their receptive organ, the stigma, found in the center of the bossom, is lightly touched 3 times, once on each lobe, with one of the male blossoms. (One male blossom carried enough pollen to polinate several females.) After this is done, the blossom is again covered with the cup for protection from visiting bees and other insects. This hand pollination may continue until 9:00 a.m. or later, if the weather is cool and cloudy. In 3 hours 50 to 100 pollinations may be made by an experienced worker.

**Third Step:** The pollinated female blossoms are examined 3 to 4 days later to see if they have "taken", i.e., whether a fruit has been formed. The failures will show a wilted or withered blossom, the positive "takes" will show a small green fruit about ¼ to 1/3 inch across. This small fruit is then tagged and a small flag placed near it for future identification. Later the hybrid fruit may be marked on the rind with a nail or another sharp instrument. Under ordinary conditions about 30 to 50 percent of the pollinated flowers will produce a fruit. All fruits are left in the field until they are fully ripe.

When a very large number of pollinations are to be made, the male parent may be planted in isolation, about ½ mile from the female parent. Under such circumstances, the covering of male blossoms with cups would be unnecessary.

**A mature watermelon, about one inch in diameter produced in a 4-inch pot. These thumb-size fruits are useful in making hybrid combinations for various studies. The unusually small size of the fruit is caused by the limited space in which "the vine" is growing.**

Another field method to be tried is to plant the two parents in alternate rows and to keep all the male buds on the female row picked off. A colony of bees may be introduced by blossoming time to do the pollinating.

**Male and female flower buds of a watermelon plant (enlarged about 3 times).**

## Summary

Watermelon hybrids for commercial use have been studied by the Mississippi Agricultural Experiment Station. One outstanding advantage of using first generation hybrids is that in them many very desirable characteristics of both parents are inherited in a dominant manner, such as resistance to some diseases, toughness of rind, sweetness, and other internal traits—which saves years of breeding work.

The hybrids offer possibilities of greater yields, a great variety of attractive types, great uniformity of marketable melons within a particular hybrid, possibilities of early maturity, better fruit setting under adverse conditions, and in some cases superior eating qualities.

Their cultivation may be made feasible through the use of transplants in perishable pots, which saves seed and offers other advantages. Suggestions for producing hybrid seed are given.

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# Contract Egg Production And Use of Credit

## By Selected Producers in Mississippi

by

Frank D. Hansing

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Agricultural Experiment Station
Mississippi State University, State College, Mississippi
in cooperation with
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# CONTRACT EGG PRODUCTION AND USE OF CREDIT BY SELECTED EGG PRODUCERS IN MISSISSIPPI

by

Frank D. Hansing[1]

Significant changes in the nation's pattern of commercial egg production have been taking place in recent years. The South, long considered a deficit area in egg production, in 1959 produced about 25 percent of the nation's eggs compared with 20 percent in 1955.

Although total egg production has increased in the South since 1955, all states in the region have not shared in this recent expansion. Mississippi is one of the states in which egg production has increased. Part of the increase in this state undoubtedly is due to the development of egg contracting, which was first introduced in Mississippi about 1957.

## PURPOSES OF STUDY

Because of the effects contract production has had on the broiler industry, the development of contracts for egg production has aroused much interest. The question arises whether contracting will develop to the same extent for egg production as it has for broiler production, and, if it should, whether its effects on the market-supply relationship and on the geographical pattern of production would be as great for eggs as for broilers.

A study was initiated in 1959 to examine the contracts in use in certain areas in Mississippi, to determine the reasons for their development and adoption, to learn the attitudes of producers and contracting firms toward the limited experience they had had with contracts, and to study the methods and policies of credit institutions in financing egg production. Some of the findings of this study were published last summer.[2] This report is concerned primarily with ways in which the credit requirements of egg producers in Mississippi were affected by the egg contracts.

### Sources of Data

Data and information on the use of egg production contracts in Mississippi and on attitudes toward the use of such contracts were obtained from 11 contracting firms who sold feed and other supplies to farmers and who contracted with farmers for the production of commercial eggs. The areas in which these contracting firms operated consisted chiefly of Alcorn, Tishomingo, Prentiss, Lee, and Itawamba counties in the northeastern part of the state and the south-central counties of Hinds, Rankin, Scott, Newton, Lauderdale, Copiah, Simpson, Smith, Jasper, Scott, and Clarke.

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[2] Sims, John C., "Contractual Arrangements in Mississippi Commercial Table Egg Industry", AEc. M. R. No. 33, Mississippi Agricultural Experiment Station, June, 1961.

[1] Agricultural Economist, Farm Economics Division, Economic Research Service, U. S. Department of Agriculture. The author expresses gratitude to Dr. Fred L. Garlock, Farm Economics Division, ERS, and to Dr. A. D. Seale, Jr., Professor, and to Mr. John C. Sims, formerly Research Assistant, Department of Agricultural Economics, Mississippi State University, for their assistance in planning the study and reviewing the manuscript.

Information was also obtained from a random sample of 84 contract producers who lived in these areas and from an equal number of independent producers, some of whom lived outside these areas.

Information on credit used by egg producers was obtained from 20 lending institutions, including local banks, production credit associations, Federal land bank associations, and local offices of the Farmers Home Administration in the above counties. Officers of these institutions were interviewed and information was obtained on loans made by the institutions to 151 of their borrowers who produced commercial eggs. The data do not include credits that may have been obtained by these producers from other sources. Moreover, although the 151 producers included virtually all egg producers whom the institutions visited were financing, they may not be representative of all producers in the contracting areas or of egg producers in other parts of the state.

## CONTRACTING FOR EGG PRODUCTION IN MISSISSIPPI

### Reasons for Contracting

Both contracting firms and contract producers were asked why they had undertaken contract production of eggs. Although various reasons were given, they added up to the fact that contracting provided both groups with opportunities to expand their operations and income.

Several of the contractors reported that contracting offered a way of increasing sales of feed and other supplies; others said in more general terms that contracting looked like a good business venture. A reason given by several contractors was that they were interested in helping farmers to develop other sources of income since cotton and other row crops were declining in importance.

The contract producers, when asked the same question, mainly gave reasons why they were producing commercial eggs rather than reasons why they were producing under contract. About 60 percent stated that their commercial egg enterprise had either replaced cotton and other row crops or supplemented other sources of income. However, a number reported that contractual arrangements provided a guaranteed market for their eggs or that contracts enabled them to produce eggs with less capital investment and fewer risks than would otherwise have been the case.

Although most contract egg programs were originally promoted through the initiative of contracting firms, many producers were anxious to become a part of these programs after they were started. When producers were asked whether they or the contracting firm made the first move to arrange for producing eggs under contract, 70 percent replied that they made the first inquiry while 30 percent said the contracting firm made the first move.

A factor influencing the producers to enter contract programs was the difficulty and risk in obtaining necessary capital for egg production. While they were looking for an enterprise to replace reduced acreages of row crops, many were fearful of the risks involved in investing the large amount of capital necessary to enter the egg laying business as independent producers. Through contracting arrangements, they could get assistance in obtaining needed capital and in finding markets for their eggs and under some types of contracts they could pass most of the risks of production and marketing to the contracting firm.

The contractors realized that in order to expand their feed and supply businesses they either would have to help farmers obtain capital and get better markets for their eggs or else themselves supply capital and take over the marketing of eggs. Either way they became involved in egg marketing. Contractors thus became involved with chain stores and other large egg buyers who were interested in lining up dependable sources of large quanities of uniformly high quailty eggs. The contractors found that contracting enabled them to develop larger and more stable volumes and thereby to reduce their unit cost of operation. They also have found that by contracting they could bring about a more rapid adoption of technological improvements in production and distribution than otherwise would occur in their areas.

### Firms Offering Contracts

A large cooperative and 10 other firms were found to be contracting for commercial egg production in those parts of Mississippi covered by this study. The cooperative is a purchasing and marketing association—a federation of the county cooperatives located throughout the state. Not all of the member cooperatives, however, contracted for eggs. Six of the other contracting firms began operations as feed businesses. Four firms started in some other line of business. One was a farmer who later purchased a small mill and started mixing feed. Three started as general stores which sold farm supplies. Later they added feed mills as a part of their businesses.

In addition to their feed operations, most of the contracting firms had taken on other functions of commercial egg production. Six of the eleven firms had their own hatchery supply flocks and five had their own hatcheries. Ten of the eleven had their own processing stations or financial interests in stations through which their eggs could be processed and market arrangements completed.

### Size of Contract Operations

Despite the short time egg contracting had been in existence in Mississippi, the 11 firms covered by this study had 497 producers under contract in 1959. The cooperative had more than one-half of these contracts and the other 10 contractors had an average of about 20, ranging from 4 to 35 per firm.

The sizes of producers' flocks in 1959 varied but two-thirds were in the 2,000-3,000 size group, as shown by the following tabulation.

| | Percent |
|---|---|
| Less than 1,000 | 0.2 |
| 1,000 to 1,999 | 3.0 |
| 2,000 to 2,999 | 67.5 |
| 3,000 to 3,999 | 8.2 |
| 4,000 to 4,999 | 14.7 |
| 5,000 and more | 6.4 |
| | 100.0 |

When asked about future plans for expanding production, 6 of the 11 contracting firms, including the cooperative, reported that they planned to increase both the number of producers under contract and the average size of flock. Three dealers planned to keep the same number of producers under contract, but to increase the number of hens per producer. One contractor reported that he had no plans for expansion; only one planned to decrease the size of his operation.

According to the contracting firms, the number of producers that they will try to place, or keep under contract, will be determined largely by the market outlets for eggs. About 50 percent of the contractors mentioned this as the most important consideration in changing the number of producers. Other considerations included the need for enough producers to result in an economical size of operation and sufficient sales to show a net return to the agency.

### Types of Contracts

None of the 11 contracting firms covered by this study offered more than one type of contract for egg production. However, the contracts offered by these firms differed in various ways. Broadly, they may be grouped into two classes: (1) guarantees and (2) marketing arrangements.

The guarantee contracts were divided further into (a) those that guaranteed payment of a specified number of cents per dozen eggs, and (b) those that guaranteed payment of a specified amount per thousand hens.

### Provisions of Contracts

The guaranteed payment per dozen eggs was most prevalent. Seven of the 11 contracting agencies offered this type of contract.

Under this type of arrangement, the contracting firm furnished the chicks or pullets, feed, medicine, and supervision necessary for the production of quality eggs. The producer furnished the laying house, equipment, and necessary labor to carry out the laying operation. As a return for his labor and investment, the producer was guaranteed a price of from 5 to 6 cents per dozen eggs.[3] In all but one of the guarantee contracts this payment was for all eggs produced; in the one exception, payment was guaranteed only for Grade A and B eggs. A few of the contracts carried bonus provisions under which the producer could make several cents per dozen above his base guarantee. The bonus provisions varied with different contracts but were usually based on feed efficiency, mortality, and rate of lay, or a combination of these. If there were not sufficient returns from egg sales to cover all of the direct production costs, the contracting agency sustained the loss.

Guaranteed payments per thousand hens were offered by two contracting agencies. Basically this is the same as the contract described above, except that the producer is paid on a monthly base per thousand hens kept. At the time this study was made, the monthly rate paid by both agencies was $75 per thousand hens for the first month and $100 per month for each succeeding month.[4]

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[3] An exception was the 1 contractor who paid his producers 10 cents per dozen eggs.

[4] This rate of payment was for producers using started pullets. If the producer started with baby chicks, he received 1 cent per week per chick until the chicks reached laying age.

Contracts offered by the cooperative and one other firm were marketing agreements only. Under this type of arrangement, the producer purchased the hens, feed, and other supplies necessary for producing eggs. He owned the house and all equipment and provided labor for producing the eggs. He agreed to purchase his feed from the contracting firm which in turn agreed to find a market for all of the producer's eggs. Eggs were delivered to the contracting agency and payments for the production items were made from egg sales. There was, however, no agreement as to the price the producer would receive for his eggs. If the returns from the egg sales were not sufficient to cover the feed, chicks, and other supplies, the producer sustained the loss.

The cooperative had a marketing arrangement which was unique in that it included a financing agreement. Under this agreement a lending agency, in most cases a commercial bank or a production credit association, provided funds to qualified producers for the construction of the laying house and equipment and, in some cases, for production expenses such as feed and chicks or pullets. The lending agency became a party to the agreement and the cooperative agreed to reimburse the lending agency for losses up to 10 percent of the amount of the loan if the producer did not pay in full.

### Selection of Producers

In contracting for egg production, the contracting firms had to choose from among persons with varying backgrounds and qualifications. Some farmers had been in the egg business on a small scale for a number of years. Others had been producing broilers. Some farmers had no experience in either broiler or egg production.

Each contracting firm had certain standards for the producers with whom it entered into contracts. Several of these standards were common to all contracting firms. In addition to the usual requirement that the producer be honest and of good character, he must live on the farm and be willing to follow directions provided by the contractor (take supervision). Most contractors wanted the producer to devote full time to the laying hen enterprise. Some contractors required that the farmer have a recommendation from his banker.

None of the contractors required producers to have previous experience in producing eggs. In fact, half of them preferred that their producers not have previous experience with laying hens. They preferred to supply producers with instructions, through their service men, that would outline almost by the hour how and when to carry out the management phases of the laying enterprises.

Contractors followed no set policy in finding farmers to produce eggs under contract. They stated that about as many farmers approached them as were approached by them. Some contractors advertised for producers, selected the more promising ones, and put the others on a waiting list. The number of producers that a dealer was willing to put under contract was determined largely by the market outlets he could establish for eggs.

When contracting began, most producers started with units of

2,000 hens. When this study was made, only two dealers reported that they would consider producers with flocks of less than 2,000 hens. Most said that they now preferred units of 4,000 to 6,000 hens. Units of this size provided more income on which to maintain the farm family and tended to keep the farmer fully employed. Most dealers said that the maximum size flock that they would contract for was 8,000 hens.

### Modifications of Contracts

Since many contracts were in their first year, there had been little opportunity for making changes. Only three contractors had modified the terms of their contracts during their brief experience with contracting. One has added a bonus plan to his guaranteed price per dozen eggs. The other two had made a change in the guarantee per dozen eggs sold —one reduced the flat guarantee and the other reduced the amount of the payment for dirty eggs. Most of the dealers were satisfied with their present arrangements but nearly half of them indicated that the contract should include an incentive or bonus plan based on efficiency factors. Five dealers reported that they planned to make some changes in their contracts, most of which would be directed toward improving the efficiency of their producers.

## FINANCING OBTAINED BY EGG PRODUCERS FROM SELECTED LENDERS

The rapid expansion of egg production in Mississippi during the two or three years before this study was made required large investments by contractors and producers for layer houses and equipment, chicks, feed, and other supplies. Since many producers had to borrow heavily in order to make these investments, a separate study was made of the credit obtained by 151 producers who had financed their operations through selected banks, production credit assocations, Federal land bank associations, and the Farmers' Home Administration. Most of the loans studied were obtained by these producers in 1958 and the first half of 1959; a few were obtained as early as 1956. The borrowers were predominantly contract producers, but some were independent producers.

Data presented on these borrowers show only the amounts of credit they obtained from the indicated lenders for the production of eggs and for other agricultural purposes. The amount of capital invested by contractors in pullets, feed, and other supplies under guarantee contracts was not obtained.

### Financial Condition of Producers

The financial condition of the borrowers at the time they first arranged for the financing needed is reflected by Table 1. As nearly all borrowers produced other agricultural products, the size of their farms had considerable influence on their asset structures. On the average, the independent producers had the largest farms and owned assets more than double the value of those owned by the contract producers. Debts of the independent producers were also largest, but their net worths averaged about twice as large as those

**Table 1. Average value of assets and liabilities of 144 egg producers using indicated credit sources at the time of applying for loan, Mississippi, 1956-59[1]**

| Item | Independent producers | Contract producers | | All producers |
|---|---|---|---|---|
| | | Guarantee | Marketing | |
| | Number | Number | Number | Number |
| Number of producers | 22 | 85 | 37 | 144 |
| Average size of farm, acres | 182 | 106 | 101 | 116 |
| Assets: | Dollars | Dollars | Dollars | Dollars |
| Farm real estate | 24,568 | 13,295 | 12,953 | 14,930 |
| Machinery and equipment | 5,910 | 2,162 | 2,982 | 2,946 |
| Livestock and poultry | 6,695 | 1,598 | 2,273 | 2,549 |
| Financial | 3,127 | 944 | 468 | 1,155 |
| Other farm | 1,483 | 796 | 1,326 | 1,037 |
| Other nonfarm | 2,227 | 550 | 597 | 818 |
| Total | 44,010 | 19,345 | 20,599 | 23,435 |
| Liabilities: | | | | |
| Commercial banks | 1,610 | 797 | 654 | 885 |
| Federal land banks | 1,471 | 406 | 817 | 674 |
| Production credit associations | 1,679 | 293 | 364 | 523 |
| Farmers' Home Administration | 791 | 187 | 0 | 231 |
| Dealers | 412 | 86 | 131 | 147 |
| Others | 2,049 | 477 | 724 | 781 |
| Total | 8,012 | 2,246 | 2,690 | 3,241 |
| Net worth | 35,998 | 17,099 | 17,909 | 20,194 |

[1]Data were not obtained for 7 producers.

**Table 2. Percentage distribution of 151 egg producers borrowing from selected lenders, by net worth at the time of applying for loan, Mississippi, 1956-59.**

| Net Worth | Independent producers | Contract producers | | All producers |
|---|---|---|---|---|
| | | Guarantee | Marketing | |
| | Percent | Percent | Percent | Percent |
| Less than $5,000 | 4 | 4 | 3 | 4 |
| $5,000 to $9,999 | 5 | 14 | 24 | 15 |
| $10,000 to $14,999 | 18 | 37 | 41 | 35 |
| $15,000 to $24,999 | 23 | 34 | 24 | 30 |
| $25,000 to $49,999 | 32 | 9 | 0 | 10 |
| $50,000 and more | 18 | 2 | 8 | 6 |
| Total | 100 | 100 | 100 | 100 |

of the contract producers.

The larger financial resources of the independent producers is reflected also by the distribution of the producers according to net worth (Table 2). Half of the independents, compared with only about 10 percent of the contract producers, had net worths of $25,000 or more. These data might be interpreted to mean that the contract producers had sought contracts because they were less able than the independent producers to assume the risks of producing on their own. However, those who had marketing contracts assumed nearly as large risks as did the independent producers and yet their net worths averaged only slightly larger than those of the producers who had guarantee contracts.

On the average, the producers who financed their operations at commercial banks and the Federal land banks had the largest net worths whereas those who obtained financing from the Farmers' Home Administration were in the weakest financial position (Table 3).

### Relative Importance of Sources of Credit

The production credit associations were the major sources of loans to the 151 borrowers obtaining credit from the indicated lenders, (Table 4). They extended about 86 percent of the loans used by these borrowers for current production, (pullets, feed and other supplies) and nearly 60 percent of the credit used for facilities (laying houses and equipment). Banks were the only other source of production loans, and were the second most important source of facility loans for the borrowers who had guarantee contracts. For independents and producers who had marketing contracts, the Federal land bank was the second most important source of facility loans.

### Average Amount of Credit Obtained

On the average, the independent producers obtained loans amounting to more than $11,000 each during the period covered, compared with about $8,500 for the producers with marketing contracts and $6,700 for those with guarantee contracts (Table 5). Some of the money borrowed was used for general farming purposes and to repay other debts but the greater part was used to establish and conduct egg laying operations—chiefly to obtain housing and equipment.

The difference between the financial obligations assumed by guarantee contract producers and those assumed by independents and producers having marketing agreements is shown clearly by the relative amounts borrowed for production expenses. Under the guarantee contracts, the contracting firm furnished the pullets, feed and most other current expense items as its part of the arrangement. As the guarantee contract producers did not have to buy these, their borrowings for current expenses of egg production were negligible. In contrast, the independents and the producers with

Table 3. **Average size of farm and average net worth of 151 egg producers borrowing from indicated lenders at the time of applying for loan, by lending agency, Mississippi, 1956-59.**

| Lending Agency | Number of producers[1] | Size of Farm | Net worth |
|---|---|---|---|
| | Number | Acres | Dollars |
| Production credit association | 84 | 109 | 19,668 |
| Bank | 34 | 120 | 26,770 |
| Farmers' Home Administration | 15 | 111 | 14,102 |
| Federal Land Bank | 11 | 163 | 26,744 |

[1] Data were not obtained for 7 producers.

marketing contracts had to buy the pullets and feed for their operations, and the data show that they borrowed substantial amounts for this purpose.

Independent producers had, on the average, the largest flocks (5,000 hens at the time the study was made) but they borrowed somewhat less for facilities than did producers with guarantee contracts. As many of the independents had been producing eggs for years, the facilities acquired with the loans probably did not represent all of their production facilities. But egg production was new to many of the contract producers. Of these producers, those with guarantee contracts had flocks of largest average size (4,200 hens compared with 2,600 hens for producers with marketing agreements) and borrowed the largest amounts for facilities.

### Interest Rates

Interest rates on loans ranged between 4 and 8 percent. More than 80 percent of the loans were obtained at either 5 3/4 or 6 percent (Table 6). Only 7 percent were obtained at rates higher than 6 percent. In general, rates averaged slightly higher on loans for production purposes than on those for facilities. No loans were obtained for production purposes at less than 5 3/4 percent. All of the production loans were obtained from the production credit associations and commercial banks. The rates charged by the production credit associations averaged slightly lower than those charged by the banks.

Interest rates on facility loans ranged from 4 to 8 percent but on 60 percent the rate was 6 per-

**Table 4. Percentage distribution of loans obtained by 151 egg producers borrowing from the indicated lenders for production and facilities, by lending agency, Mississippi, 1956-59.**

| Lending agency | Loans for production obtained by | | | | Loans for facilities obtained by | | | | All loans to producers |
|---|---|---|---|---|---|---|---|---|---|
| | Independent producers | Contract producers | | All producers | Independent producers | Contract producers | | All producers | |
| | | Guarantee | Marketing | | | Guarantee | Marketing | | |
| | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| Production credit association | 72 | 59 | 100 | 86 | 57 | 60 | 58 | 59 | 65 |
| Bank | 28 | 41 | 0 | 14 | 12 | 29 | 6 | 21 | 20 |
| Farmers' Home Administration | 0 | 0 | 0 | 0 | 8 | 9 | 0 | 7 | 5 |
| Federal land bank | 0 | 0 | 0 | 0 | 23 | 2 | 36 | 13 | 10 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

cent and on 33 percent it was less than 6 percent. The rates charged on loans obtained by independent producers for facilities tended to be slightly lower than those for either of the contract groups. Among the lenders that financed construction of facilities, the Farmers' Home Administration and the Federal land bank charged the lowest rates of interest.

### Term of Loans

The terms of the loans were related to the purposes for which they were obtained and to the type of lending agency making the loans (Table 7). Production loans, which were obtained only from the production credit associations and the commercial banks, usually matured in relatively short periods; 71 percent were written to mature within 1 year. Loans obtained by independent and guarantee contract producers usually had terms of 1 year or less, whereas the majority of loans obtained by market contract producers had terms longer than 1 year.

Facility loans sometimes ran considerably longer—a few for more than 20 years. However, 66 percent were written for 1 year or less, and 18 percent for periods ranging up to 6 years. The loans of short duration were obtained from production credit associations and commercial banks. Contract producers with marketing arrangements had more facility loans with 1 to 6 year maturities than did either independents or producers under guarantee contracts. Many of the loans to market contract producers were obtained from the production credit associations under their lending agreements with the cooperative. Commercial banks made most of their facility loans for 1 year. However, some were payable on demand. Usually loans unpaid at the end of 1 year could be extended. The facility loans written for periods longer than 6 years were obtained from the Farmers' Home Administration or the Federal land bank.

### Security

Most lending agencies do not consider poultry alone as sufficient collateral for a loan. The tendency in the cases studied was for most loans for both current production and facilities to be secured with real estate mortgage. All but

Table 5. **Average amount of loans obtained by 151 egg producers from selected lenders by purpose of loan, Mississippi, 1956-59.**

| Item | Independent producers | Contract producers | | All producers |
|---|---|---|---|---|
| | | Guarantee | Marketing | |
| | Number | Number | Number | Number |
| Number of producers | 25 | 88 | 38 | 151 |
| Loans for — | Dollars | Dollars | Dollars | Dollars |
| Building poultry houes | 5,213 | 5,802 | 4,825 | 5,459 |
| Production expenses (feed and pullets) | 4,626 | 122 | 3,361 | 1,683 |
| Paying other debts | ........ | 766 | 238 | 506 |
| General farm purposes | 1,243 | 52 | 44 | 247 |
| All purposes | 11.082 | 6.742 | 8.468 | 7.895 |

**Table 6. Percentage distribution of loans obtained by 151 egg producers borrowing from selected lenders for production and facilities, by interest rate, Mississippi, 1956-59.**

| Interest rate | Loans for production obtained by | | | | Loans for facilities obtained by | | | | All loans to producers |
|---|---|---|---|---|---|---|---|---|---|
| | Independent producers | Contract producers | | All producers | Independent producers | Contract producers | | All producers | |
| | | Guarantee | Marketing | | | Guarantee | Marketing | | |
| | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| 4 percent | 0 | 0 | 0 | 0 | 3 | 13 | 0 | 8 | 5 |
| 4 1/2 percent | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 1 |
| 5 percent | 0 | 0 | 0 | 0 | 6 | 4 | 19 | 9 | 6 |
| 5 3/4 percent | 9 | 14 | 10 | 10 | 10 | 22 | 5 | 15 | 13 |
| 6 percent | 86 | 57 | 80 | 81 | 78 | 53 | 67 | 60 | 68 |
| 6 1/2 percent | 0 | 0 | 10 | 4 | 0 | 6 | 9 | 6 | 5 |
| 8 percent | 5 | 29 | 0 | 5 | 0 | 1 | 0 | 1 | 2 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

**Table 7. Percentage distribution of loans obtained by 151 egg producers for production and facilities by term of loan, Mississippi. 1956-59.**

| Term of loan | Loans for production obtained by | | | | Loans for facilities obtained by | | | | All loans to producers |
|---|---|---|---|---|---|---|---|---|---|
| | Independent producers | Contract producers | | All producers | Independent producers | Contract producers | | All producers | |
| | | Guarantee | Marketing | | | Guarantee | Marketing | | |
| | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| 1 year and less | 98 | 86 | 28 | 71 | 81 | 78 | 30 | 66 | 68 |
| 1.1 to 5.9 years | 2 | 14 | 72 | 29 | 10 | 6 | 51 | 18 | 22 |
| 6 to 10.9 years | 0 | 0 | 0 | 0 | 0 | 7 | 3 | 5 | 3 |
| 11 to 20.9 years | 0 | 0 | 0 | 0 | 6 | 8 | 16 | 10 | 6 |
| 21 years and more | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 1 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

3 percent of the loans were secured at least partially by real estate mortgages; 79 percent were secured by first mortgages (Table 8). Even with the production loans, 69 percent were secured by first mortgages. Chattel mortgages were accepted as security for loans more frequently by banks than by the production credit associations, but the percentage of loans so secured was not large. All loans obtained from the Federal land bank were secured by first mortgages.

### Repayment Plan

The method of repayment was tied closely to the purpose for which the loans were obtained and the type of lending agency making the loans. Of the loans obtained, 73 percent were set up on a monthly repayment plan. All of the production loans obtained from production credit associations and half of those obtained from commercial banks were to be repaid on a monthly basis, (Table 9).

Almost 63 percent of the facility loans were on a monthly repayment schedule. Most of these loans were obtained from production credit associations and commercial banks by independent and guarantee contract producers. Almost three-fourths of the loans to market contract producers were to be repaid on a semi-annual or annual basis. These loans were obtained chiefly from the production credit associations and the Federal land bank.

### Conclusions

The data used in this study were collected in 1959. Since then, egg production in Mississippi has continued to increase rapidly. According to trade reports, some of the contracting firms have enlarged their operations greately. Egg production in Mississippi appears to be following a pattern established earlier in the broiler industry. With broilers, contracting provided a means of integrating the various phases of production and marketing and increasing the efficiency of the industry. It brought larger-size units of production, lower costs, and an expanded market. This seems to be happening in the egg industry in Mississippi. To the extent that its development continues in this direction, capital requirements of egg producers in Mississippi will continue to increase and local credit institutions will be requested by such producers to provide additional financing.

Table 8. Percentage distribution of loans obtained by 151 egg producers for production and facilities by type of security, Mississippi, 1956-59.

| Type of security | Loans for production obtained by |  |  |  | Loans for facilities obtained by |  |  |  | All loans to producers |
|---|---|---|---|---|---|---|---|---|---|
|  | Independent producers | Contract producers |  | All producers | Independent producers | Contract producers |  | All producers |  |
|  |  | Guarantee | Marketing |  |  | Guarantee | Marketing |  |  |
|  | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| First mortgage on real estate | 62 | 86 | 76 | 69 | 74 | 86 | 84 | 83 | 79 |
| Second mortgage on real estate | 20 | 14 | 10 | 16 | 16 | 9 | 7 | 10 | 12 |
| Chattel mortgage | 9 | 0 | 0 | 5 | 3 | 2 | 2 | 2 | 3 |
| First mortgage on real estate and chattel mortgage | 9 | 0 | 10 | 9 | 7 | 2 | 5 | 4 | 5 |
| First and second mortgage on real estate | 0 | 0 | 4 | 1 | 0 | 1 | 2 | 1 | 1 |
| All mortgages | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Table 9. Percentage distribution of loans obtained from selected lending agencies for production and facilities, by repayment plan, Mississippi, 1956-59.

| Repayment plan | Loans for facilities obtained from |  |  |  |  | Loans for production obtained from |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  | Production credit associations | Banks | Farmers Home Administration | Federal Land Banks | All agencies | Production credit associations | Banks | Farmers Home Administration | Federal Land Banks | All agencies |
|  | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| Monthly | 100 | 50 | 0 | 0 | 94 | 72 | 74 | 25 | 0 | 63 |
| Quarterly | 0 | 40 | 0 | 0 | 5 | 0 | 10 | 0 | 0 | 2 |
| Semi-annual | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 92 | 2 |
| Annual | 0 | 10 | 0 | 0 | 1 | 28 | 8 | 75 | 8 | 27 |
| Total | 100 | 100 | 0 | 0 | 100 | 100 | 100 | 100 | 100 | 100 |

## Digest

1. Despite the short time egg contracting had been in existence in Mississippi at the time of this study, 11 firms in selected areas had 497 producers under contract to produce eggs.

2. Broadly, contracts were grouped into two classes, guarantees and marketing arrangements. Guarantee contracts were further divided into two types, (a) those that guaranteed payment of a specified number of cents per dozen eggs, and (b) those that guaranteed payment of a specified amount per thousand hens.

3. A large cooperative association and one other firm offered marketing contracts; 9 firms offered guarantee contracts.

4. Both the contracting firms and the producers they had under contract stated that contracting provided opportunities for expanding their operations and income. For the contracting firms, the contracts provided a dependable source of high quality eggs. Producers like the contracts because they provided a market for their eggs and, in the case of the guarantee contracts, a means of shifting part of the financial risks of egg production to the contracting firms.

5. The contracting firms stated that the number of producers they would try to keep under contract would depend largely on their market outlets for eggs.

6. As a general rule, the producers who operated under contracts were less strong financially than those who continued to operate independently. Assets and net worths of the contract producers averaged only about half as large as those of independent producers.

7. The rapid increase in egg production in Mississippi in the last few years preceding this study required a heavy investment by both producers and contractors in pullets, feed, equipment and laying houses. Many producers had to borrow heavily in order to make these investments.

8. A sample of 151 egg producers who borrowed from selected lenders was included in the study. Production credit associations loaned the largest amount to these borrowers. Banks were the next most important source. Both the Federal Land Bank and the Farmer's Home Administration provided some loans for laying houses. No attempt was made in the study to estimate the amounts of capital and credit furnished to egg producers either directly or indirectly by feed dealers and other contractors.

9. Among the 151 producers who financed their operations through these institutions, the producers with guarantee contracts borrowed the smallest amounts. This was chiefly because they did not need credit for pullets and feed. The contracting firms furnished these production inputs as their part of the arrangement, and they also absorbed the loss if the cost of these items was not covered by returns from sales of eggs.

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# Amino Acid Content of Experimental Diets Containing Various Amounts of Protein

By

ANN R. STASCH and LOIS KILGORE

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JUL 31 1970
MISSISSIPPI STATE UNIVERSITY

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AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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# AMINO ACID CONTENT OF EXPERIMENTAL DIETS CONTAINING VARIOUS AMOUNTS OF PROTEIN[1]

by

ANN R. STASCH and LOIS KILGORE

## INTRODUCTION

Protein deficiency in the diets of young children is recognized throughout the world as a serious and widespread nutrition problem. This deficiency arises not only as a result of lack of availability of protein foods, but also because of failure on the part of many parents to recognize the importance of protein in the diets of growing children. A broader dissemination and understanding of the already available knowledge of protein nutrition could eliminate some of the needless malnutrition throughout the world today. The authors hope that the information contained in this bulletin will be of value to parents, particularly those who have school age children, as well as to professional people.

## GENERAL LITERATURE REVIEW

### Importance of Adequate Protein in the Diet

Protein, along with fat, carbohydrate, vitamins, minerals and water, is an essential foodstuff for the human body. Protein is a vital constituent of every living cell. During growth and normal living processes protein tissues must be built and maintained by the body through the manufacture of protein molecules, which are complex stuctures of amino acids. The kind, number and arrangement of amino acids vary in the various kinds of proteins. Since the protein needed for life processes and normal functioning of the body is built up from amino acids, the food proteins have as one of their major functions the supply of amino acids to the body. Any protein food must be digested or broken down into its component amino acids before it can be utilized.

Although many amino acids are required by the body for the synthesis of protein, there are only eight which are required as **preformed** constituents of the food protein. From these amino acids, and other compounds, including nitrogen, the body can synthesize its own supply of the other required amino acids. The eight amino acids, which are essential components of the protein foods eaten, are called the essential or indispensable amino acids. They are isoleucine,

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[1] This study was a phase of the Southern Regional Research Project, "Requirements and Utilization of Selected Nutrients by Preadolescent Children", supported in part by funds appropriated to the U. S. Department of Agriculture under the Research and Marketing Act of 1946 and the Hatch Act, as amended, and in part by seven Southern Agricultural Experiment Stations. The Human Nutrition Research Division of the Agricultural Research Service was a cooperator in this project.

leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. All the others are called non-essential, or dispensable amino acids, since they are not required as **pre-formed** constituents of the dietary protein. Among the more common of the dispensable amino acids are alanine, arginine, aspartic acid, citrulline, cysteine, cystine, glycine, glutamic acid, histidine, hydroxyproline, proline, serine, thyroxine and tyrosine. Both the essential and the non-essential amino acids are required for the manufacture of protein molecules.

Normal metabolism is also required for normal protein manufacture. For example, when both the thyroid and the pituitary glands are functioning normally, the body manufactures all of the thyroxine it needs. When these glands do not function normally, goiter or cretinism can result. Sometimes, too, in abnormal metabolism the essential amino acids are not converted to the non-essential amino acids. For example, an inborn error of metabolism can prevent conversion of the essential amino acid phenylalanine to the non-essential amino acid tyrosine. When this occurs, a disease called phenylketonuria, which causes serious mental retardation, may result. However, these ailments are a result of abnormal metabolism, rather than a deficiency of protein.

## Some Results of Protein Deficient Diets

Nutritional surveys in the United States have shown that the majority of boys and girls up to the age of 13 years receive amounts of protein daily which equal or exceed recommended amounts (25). The amounts of protein recommended for children by the National Research Council (28) are:

| Age of Child | Protein per day, grams |
|---|---|
| 1 - 3 years | 40 |
| 4 - 6 years | 50 |
| 7 - 9 years | 60 |
| 10 - 12 years | 70 |

In spite of the fact that most children in this country receive adequate amounts of protein, some cases of severe protein deficiency and general malnutrition do occur. Kwashiorkor is a severe protein deficiency disease which is precipitated by a stress condition after weaning in children whose diet is high in carbohydrate and very low in protein (6). Cases of kwashiorkor have been reported in Louisiana (10), Kentucky (1), Illinois, and North Carolina (38). Cases of human growth failure in children and adolescents due to multi-nutrient deficiencies have been reported in Alabama (32). The condition was corrected by addition of non-fat milk solids to the diet, indicating that protein was deficient.

Although the preponderance of the reported cases of kwashiorkor have occurred in the Southern Region of the United States, protein deficiency is not a characteristic of the diets of this region. Reports of food intake in the families of gainfully employed homemakers in Mississippi, have shown that only six percent of Negro urban families, nine percent of Negro rural families and one percent of white rural families have intakes of proteins which are less than two-thirds of the amount recommended by the NRC. All of the urban white families interviewed reported intake of protein greater than this amount. Therefore, the families deficient in protein intake comprise only a small proportion of the whole group (2). However, even a small number of protein deficient diets is cause for concern regarding both means of improving diets and means of making the public more generally aware of the importance of nutrition in health and fitness.

A clinical syndrome of hypoproteinosis of childhood has been reported from Indiana (23). Symptoms include peevishness, pallor, gastro-intestinal upsets, failure to gain weight, poor appetite, and frequent infections. The syndrome was found to be closely related to a diet containing adequate amounts of sweet foods, juices and milk, but insufficient solid protein food (23). The syndrome was thought to occur much more frequently than diagnosed because of lack of awareness on the part of the parents of the relationship between poor diet and poor physical condition of the child.

Teenaged girls (4), older people (39) and pregnant women (16) have been reported to suffer from insufficient protein intake, also.

## Amino Acids in Protein Foods

The amino acids are of great importance in the body for protein building and maintenance. Therefore, the analysis of protein foodstuffs for the kinds and amounts of amino acids, particularly the essential amino acids, which they contain, is important in any consideration of the nutritional adequacy of the protein in a particular diet.

Amino acid values on many individual protein foods are available in the literature (3, 37). A compilation of the amino acid content of a large number of foods has been prepared by the U. S. Department of Agriculture (29). However, only a few reports in the literature deal with the analysis of amino acids in the entire mixed diets, such as one eats every day (7, 8, 24). In the studies using mixed diets, foods were grouped for analysis in the following manner: cereals, including bread, cakes, dry breakfast cereals; meats; eggs; cheese; milk; and a food mixture, including fruits, vegetables and prepared dishes, which did not fit into the other categories. This grouping was found to give higher analytical results than those obtained when a composite sample of the whole day's diet was analyzed by microbiological assay methods. Correction factors were used in calculating the amounts of the various amino acids present (7). Later work has shown that correction factors are not necessary provided precautions are taken during the assay of amino acids by micro-organisms (11, 12).

## Human Requirements for Essential Amino Acids

Assay of foodstuffs for the amount of amino acids present can be useful only to the extent that it shows whether the amounts and kinds of amino acids required by the human body are present. However, the requirements of all age groups for the essential amino acids have not been determined. The requirements of young adult men and women for all essential amino acids, and the requirements of school age children (11-14 years old) for certain essential amino acids, have been reported in the literature. The following amounts of essential amino acids, in grams, have been reported as minimal daily requirements:

| Amino Acid | Young men (30)* | Young women | School age children |
|---|---|---|---|
| isoleucine | 0.7 | 0.4 (34)* | 1.0 (26)* |
| leucine | 1.1 | 0.6 (18) | 1.5 (26) |
| lysine | 0.8 | 0.5 (17) | 1.6 (27) |
| methionine | 1.1 | 0.4 (36) | 0.8 (27) |
| phenylalanine | 1.1 | 0.8 (21) | |
| threonine | 0.5 | 0.3 (20) | |
| tryptophan | 0.3 | 0.2 (22) | |
| valine | 0.8 | 0.6 (19) | |

*Numbers in parentheses refer to Literature Cited.

The Food and Agricultural Organization of the United Nations (FAO) has established a reference pattern for protein based on the available information on requirements for each age group (5). Whole egg has also been used often as a reference protein (29). These reference proteins contain the following amounts of essential amino acids in grams per 100 grams of protein:

| Amino Acid | FAO Protein | Whole Egg Protein |
|---|---|---|
| isoleucine | 4.2 | 6.5 |
| leucine | 4.8 | 10.0 |
| lysine | 4.2 | 7.9 |
| methionine | 2.2 | 2.5 |
| phenylalanine | 2.8 | 4.9 |
| threonine | 2.8 | 4.7 |
| tryptophan | 1.4 | 1.4 |
| valine | 4.2 | 7.0 |

It can be seen from the above that whole egg contains more of all of the essential amino acids than the FAO reference protein, except in the case of tryptophan. Both proteins contain the same amount of this amino acid. Whole egg is therefore a good source of protein in a diet. Studies comparing the egg and FAO reference patterns of amino acids, when fed to young men, have shown that similar nitrogen balance patterns are obtained with both (35). This simply means that these two reference proteins are metabolized in much the same way.

Further work on the amounts and proportions of amino acids required by man at various ages and stages of growth is necessary to permit accurate assessment of quantities and kinds of foods needed to fulfill the optimal protein requirements of expanding populations the world over. Food is the only source of the essentia amino acids. Therefore, analyses of the foods eaten are necessary to give us a proper evaluation of daily intake of amino acids. This bulletin is a report of the actual amino acid content of some diets fed to preadolescent girls.

## EXPERIMENTAL PROCEDURE AND RESULTS

This project was undertaken as a contribution to Southern Regional Nutrition Research Project, S-28, which had as its overall objective the assessment of metabolic patterns in preadolescent (7 to 10 year old) girls when various amounts of protein were fed. The specific objective of the Mississippi contributing project was the analysis of the experimental diets for certain amino acids. This project provided an unusually good opportunity to present to interested parents a report of the actual amounts of amino acids provided by definite menu patterns.

Diets were made up of individual daily menus, including both meals and snacks, selected to provide various predetermined daily amounts of protein to the girls participating in the metabolic study. A different diet was provided for each day of a four or six day study period to relieve monotony and make the meals more attractive to the girls. For convenience the same daily menus were repeated in subsequent periods of each experimental study. A wide variety of foods generally acceptable to children was used in preparing the menus, to insure the presence of all other required nutrients, as well as protein.

Diet 1 was prepared at two different locations (Louisiana and Tennessee), using the same brands of canned and packaged foods. Meat was purchased in one lot at each location and frozen for use throughout the study. All items were standardized to the greatest possible extent.

Diets 2, 3, 4, 5, 6, 7 and 8 were prepared at one location (Virginia), which simplified the maintenance of uniformity in the diets. For Diet 8 all foods, except staples and fresh fruits and vegetables, were purchased or prepared in advance and stored frozen, including single supplies of homogenized and skim milk.

The daily menus comprising the different diets are given in Tables 1 through 8. Diets and details of preparation of certain foods are reported in greater detail in Southern Cooperative Series Bulletin No. 64 (31). Calculated and analyzed mean protein values for these diets have been reported elsewhere (19). The analyzed mean protein values ranged from 18.2 grams in Diet 8 to 88.2 grams in Diet 5.

### Preparation of Food Samples

As each meal was being served, one-half serving portions of each food were blended with water and stored in a refrigerator. At the end of each period the whole amount of food collected was blended with water and diluted to a known weight. Since Diet 1 was served at two locations, samples for amino acid assay were collected at each location. The diet was served for a total of 16 periods, but amino acid assays were made only on food samples from the even-numbered periods from each location, a total of 16 replicated samples of Diet 1. Diets 2, 3, 4, and 5 were assayed only during even-numbered periods of a 14 period study, making a total of seven replicated samples of each diet. Four replicated samples of Diets 6 and 7 were assayed for amino acids, one for each period. Samples from Diet 8 were replicated eight times from an 8-period study. Separate analyses were made on milk.

### Amino Acid Assays

All of the amino acids except tryptophan were assayed by the use of microorganisms. The particular microorganisms used were **Leuconostoc mesenteroides** and **Streptococcus faecalis**. Both of these microorganisms require amino acids, as well as other nutrients, for growth, and both produce lactic acid as they grow. When all of the other required nutrients are present in the necessary amounts, the amount of growth of the microorganisms depends only on the amounts of various amino acids present in the medium. Growth can be measured by the amount of lactic acid produced. Therefore, the amount of lactic acid produced is directly related to the amount of that particular amino acid present. The same procedure is repeated to determine the amounts of the other amino acids present. Further details of amino acid assay are given in Appendix A.

Diets 1, 6 and 7 were analyzed for the following amino acids: arginine, cystine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. Diets 2, 3, 4, 5, and 8 (without milk) were analyzed for the following amino acids: arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine and valine. Results, in grams per 100 grams of protein, are given in Appendix B. Analyses of milk from Diet 8 are reported for the same amino acids in Table 9.

### Discussion of Results

The amino acid content of these diets was found to vary both when diets containing different amounts of protein were analyzed and when the same diet was analyzed at different times. However, the variation between different diets was greater than that between different analyses of the same diet. The variation found between different analyses of the same diet is due to the natural variation found in all foods at different times. This simply means that the steak one buys today will contain slightly different amounts of amino acids than the steak bought last week. The replicated analyses of Diet 1, which was prepared at two different locations, showed no greater variation in amino acid content than the other diets, all of which were prepared at the same location.

The essential amino acid content of the milk used with Diet 8 was higher than the FAO reference pattern. This is typical of milk in general. Notice should be taken, also, of the fact that although the amino acid content of whole homogenized and skim milk are not exactly the same, both of these kinds of milk supply a very good pattern of essential amino acids, when compared to the FAO reference pattern. Milk is, therefore, a very good part of a child's diet, in so far as protein nutrition is concerned. However, milk should not be the only source of protein in the diet.

As stated previously, the major reason for analysis of a diet for its amino acid content is to determine whether or not the diet contains adequate amounts of the essential amino acids, and sufficient excess of these or other amino acids to supply needed nitrogen. For comparative purposes, therefore, Table 10 is arranged to contain both mean values of amino acids found in the experimental diets and values found in the FAO reference protein. The amino acid content of all of the experimental diets compares favorably with the reference pattern except for the amounts of methionine in Diets 3 and 5, and tryptophan in Diets 1, 6, and 7, which were the only diets analyzed at this station for this amino acid. This comparison is based on the amounts of the various amino acids contained in 100 grams of protein. However, the experimental diets were not fed at a level to supply 100 grams of protein, but at the lower amounts recorded in the diet tables (Tables 1 through 8).

The only way to determine whether these diets really contained enough of the essential amino acids is to determine the actual amount of each amino acid eaten each day. Therefore, calculations were made of mean daily intakes

**Table 1. Kinds and amounts of food served in Diet 1; Protein content: calculated - 60.7 grams per day; analyzed - 65.3 grams per day.**

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Orange juice | 2.1 | Pineapple juice | 3.5 |
| | Cornflakes | 0.7 | Oatmeal | 2.6 |
| | Dark brown sugar | 0.5 | Bread | 0.7 |
| | Margarine | 0.2 | Jelly | 0.4 |
| | Jelly | 0.4 | Margarine | 0.2 |
| | Milk | 8.6 | Milk | 8.6 |
| | Bread | 0.7 | Sugar | 0.1 |
| Lunch | Liver sausage | 1.1 | Tomato soup | 2.1 |
| | Lettuce | 0.4 | Bread | 1.4 |
| | Mayonnaise | 0.2 | Red Salmon | 1.4 |
| | Bun | 1.1 | Lettuce | 0.4 |
| | Coconut bars | 0.7 | Mayonnaise | 0.2 |
| | Baked custard | 3.7 | Banana | 1.8 |
| | Milk | 8.6 | Orange | 1.8 |
| | | | Gelatin | 3.5 |
| | | | Sugar | 0.1 |
| | | | Milk | 2.1 |
| Snack | Lemonade | 7.0 | Graham crackers | 0.7 |
| | Waffle cream cookies | 0.7 | Milk | 5.3 |
| | Raisins | 0.9 | Chocolate syrup | 0.7 |
| Dinner | Beef roast | 1.1 | Baked ham | 1.8 |
| | Converted rice | 1.8 | Mashed potato | 2.1 |
| | Gravy | 0.7 | Snap beans | 1.8 |
| | Broccoli | 1.8 | Gingerbread | 1.4 |
| | Vanilla ice cream | 2.8 | Applesauce | 2.5 |
| | Roll | 0.9 | Milk | 3.2 |
| | Margarine | 0.2 | Sugar | 0.1 |
| | | | Bread | 0.4 |
| | | | Margarine | 0.2 |
| Snack | Raisins | 0.9 | Bread | 0.7 |
| | Peanut butter | 0.5 | Peanut butter | 0.2 |
| | Jelly | 0.4 | Jelly | 0.4 |
| | Bread | 0.7 | | |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 3.5 | Orange juice | 3.5 |
| | Puffed wheat | 0.4 | Scrambled egg | 1.8 |
| | Roll | 1.4 | Toast | 0.7 |
| | Jelly | 0.4 | Margarine | 0.2 |
| | Margarine | 0.4 | Jelly | 0.4 |
| | Milk | 8.6 | Milk | 4.4 |
| | Dark brown sugar | 0.5 | | |
| Lunch | Prune juice | 1.8 | Baked ham | 0.9 |
| | Corned beef | 1.0 | Lettuce | 0.2 |
| | Green peas | 1.8 | Mayonnaise | 0.4 |
| | Bread | 0.7 | Bread | 1.4 |
| | Margarine | 0.4 | Prunes | 4.3 |
| | Canned peaches | 2.5 | Butter cookies | 0.7 |
| | Milk | 4.3 | Milk | 8.6 |
| Snack | Molasses cookies | 0.5 | Grape juice | 5.3 |
| | Milk | 3.2 | Graham crackers | 0.7 |
| Dinner | Ground beef | 2.0 | Chicken | 1.4 |
| | Mashed potato | 2.1 | Green lima beans | 1.8 |
| | Margarine | 0.2 | Roll | 0.9 |
| | Raw carrots | 0.1 | Margarine | 0.4 |
| | Angel food cake | 1.1 | Milk | 7.0 |
| | Icing | 0.5 | Spice cake | 1.8 |
| | Vanilla ice cream | 2.1 | Brown sugar icing | 1.1 |
| | Milk | 4.3 | | |
| Snack | Bread | 0.7 | Banana | 5.3 |
| | Jelly | 0.4 | | |
| | Raisins | 0.9 | | |
| | Cream cheese | 0.5 | | |

Table 2. Kinds and amounts of food served in Diet 2; protein content: calculated - 48.5 grams per day; analyzed - 48.1 grams per day.

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Orange juice | 4.2 | Pineapple juice | 4.2 |
| | Branflakes | 0.7 | Ralston | 0.7 |
| | Dark brown sugar | 0.5 | Dark brown sugar | 0.5 |
| | Apple butter | 0.7 | Jelly | 0.4 |
| | Bread | 0.7 | Bread | 0.7 |
| | Margarine | 0.2 | Margarine | 0.2 |
| | Milk | 7.0 | Milk | 5.3 |
| Snack | Raisins | 0.9 | Graham crackers | 0.5 |
| Lunch | Bouillon cube | 0.1 | Tomato soup | 2.1 |
| | Liver sausage | 0.7 | Tuna fish | 1.1 |
| | Bread | 1.4 | Bread | 1.4 |
| | Lettuce | 0.4 | Lettuce | 0.4 |
| | Mayonnaise | 0.2 | Mayonnaise | 0.4 |
| | Canned pears | 4.1 | Applesauce | 3.5 |
| | Molasses cookies | 0.5 | Milk | 7.0 |
| | Milk | 5.3 | | |
| Snack | Coconut cookies | 1.1 | Raisins | 0.9 |
| Dinner | Beef roast | 0.9 | Baked ham | 0.9 |
| | Gravy | 0.7 | Potato | 1.8 |
| | Potato | 1.8 | Broccoli | 1.8 |
| | Margarine | 0.2 | Gingerbread | 1.4 |
| | Green asparagus | 1.8 | Margarine | 0.4 |
| | Vanilla ice cream | 2.8 | Milk | 7.0 |
| | Chocolate syrup | 0.7 | | |
| | Milk | 7.0 | | |
| Other | Sugar in ade (powder base) | 2.1 | Sugar in ade (powder base) | 3.0 |
| | Margarine | 0.4 | Margarine | 0.2 |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 3.2 | Orange juice | 4.2 |
| | Wheat flakes | 0.4 | Ralston | 0.9 |
| | Dark brown sugar | 0.5 | Dates | 1.4 |
| | Cream | 1.1 | Dark brown sugar | 0.5 |
| | Bread | 0.7 | Jelly | 0.4 |
| | Margarine | 0.2 | Bread | 0.7 |
| | Milk | 7.0 | Margarine | 0.2 |
| | | | Milk | 7.0 |
| Snack | Graham crackers | 0.2 | Graham Crackers | 0.2 |
| | | | Peanut butter | 0.4 |
| Lunch | Prune juice | 3.5 | Cheese food | 1.0 |
| | Cheese food | 0.5 | Bread | 1.4 |
| | Bread | 1.4 | Lettuce | 0.4 |
| | Lettuce | 0.4 | Mayonnaise | 0.2 |
| | Mayonnaise | 0.2 | Canned plums | 3.5 |
| | Canned peaches | 2.5 | Milk | 5.3 |
| | Milk | 5.3 | | |
| Snack | Graham crackers | 0.2 | Graham crackers | 0.2 |
| Dinner | Ground beef | 1.1 | Baked ham | 1.1 |
| | Potato | 2.6 | Potato | 1.8 |
| | Green peas | 2.1 | Margarine | 0.4 |
| | Bread | 0.4 | Snap beans | 1.4 |
| | Margarine | 0.4 | Canned apricots | 3.5 |
| | Vanilla ice cream | 2.1 | Milk | 7.0 |
| | Milk | 7.0 | | |
| Other | Sugar in ade (powder base) | 3.0 | Sugar in ade (powder base) | 3.0 |
| | Margarine | 0.5 | | |

**Table 3. Kinds and amounts of food served in Diet 3; protein content: calculated - 72.6 grams per day; analyzed - 72.8 grams per day.**

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Orange juice | 4.2 | Orange juice | 1.8 |
| | Cornflakes | 0.7 | Pineapple juice | 4.2 |
| | Dark brown sugar | 0.5 | Egg | 1.6 |
| | Apple butter | 0.7 | Bread | 0.7 |
| | Margarine | 0.2 | Margarine | 0.2 |
| | Bread | 0.7 | Milk | 5.3 |
| | Milk | 7.0 | | |
| Snack | Raisins | 0.9 | Milk | 5.3 |
| | | | Graham crackers | 0.5 |
| Lunch | Chicken | 1.8 | Tomato soup | 2.1 |
| | Raw carrots | 0.4 | Tuna fish | 1.1 |
| | Bread | 1.4 | Bread | 1.4 |
| | Lettuce | 0.4 | Lettuce | 0.4 |
| | Mayonnaise | 0.2 | Mayonnaise | 0.4 |
| | Canned pears | 4.1 | Applesauce | 3.5 |
| | Molasses cookies | 0.5 | Sugar wafer | 1.1 |
| | Milk | 5.3 | Milk | 5.3 |
| Snack | Coconut cookies | 1.1 | Raisins | 0.9 |
| Dinner | Beef roast | 2.8 | Baked ham | 2.6 |
| | Gravy | 0.7 | Potato | 1.8 |
| | Potato | 1.8 | Green lima beans | 3.5 |
| | Green asparagus | 1.8 | Gingerbread | 1.4 |
| | Vanilla ice cream | 2.8 | Bread | 0.4 |
| | Margarine | 0.2 | Margarine | 0.4 |
| | Milk | 7.0 | Milk | 3.5 |
| Other | Sugar in ade (powder base) | 1.0 | Sugar in ade (powder base) | 0.5 |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 3.2 | Orange juice | 4.2 |
| | Wheat flakes | 0.4 | Ralston | 0.9 |
| | Dark brown sugar | 0.5 | Dates | 1.4 |
| | Egg | 1.8 | Dark brown sugar | 0.5 |
| | Bread | 0.7 | Jelly | 0.4 |
| | Margarine | 0.2 | Bread | 0.7 |
| | Milk | 7.0 | Margarine | 0.2 |
| | | | Milk | 7.0 |
| Snack | Graham crackers | 0.2 | Graham crackers | 0.2 |
| Lunch | Prune juice | 3.5 | Cheese food | 1.0 |
| | Cheese food | 1.2 | Chicken | 1.6 |
| | Bread | 1.4 | Bread | 1.4 |
| | Lettuce | 0.4 | Lettuce | 0.4 |
| | Mayonnaise | 0.2 | Mayonnaise | 0.2 |
| | Canned peaches | 2.5 | Canned plums | 3.5 |
| | Milk | 5.2 | Milk | 5.3 |
| Snack | Graham crackers | 0.2 | Graham crackers | 0.2 |
| | Peanut butter | 0.5 | | |
| Dinner | Ground beef | 1.9 | Baked ham | 2.3 |
| | Potato | 1.8 | Potato | 1.8 |
| | Green peas | 2.1 | Snap beans | 1.4 |
| | Vanilla ice cream | 2.1 | Canned apricots | 3.5 |
| | Bread | 0.4 | Margarine | 0.4 |
| | Margarine | 0.4 | Milk | 7.0 |
| | Milk | 7.0 | | |
| Other | Gelatin in ade (powder base) | 0.2 | Gelatin in ade (powder base) | 0.2 |
| | Sugar in ade (powder base) | 1.9 | Sugar in ade (powder base) | 0.9 |
| | Margarine | 0.2 | Pineapple juice | 0.4 |
| | Pineapple juice | 0.4 | | |

Table 4. Kinds and amounts of food served in Diet 4; protein content: calculated - 58.6 grams per day; analyzed - 58.7 grams per day.

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Orange juice | 4.2 | Pineapple juice | 4.2 |
| | Branflakes | 0.7 | Ralston | 0.7 |
| | Dark brown sugar | 0.5 | Dark brown sugar | 0.5 |
| | Apple butter | 0.7 | Jelly | 0.4 |
| | Bread | 0.7 | Cream | 1.1 |
| | Margarine | 0.2 | Bread | 0.7 |
| | Milk | 7.0 | Margarine | 0.2 |
| | | | Milk | 5.3 |
| Snack | Raisins | 0.9 | Graham crackers | 2.1 |
| Lunch | Bouillon cube | 0.1 | Tomato soup | 2.1 |
| | Liver sausage | 0.7 | Tuna fish | 1.1 |
| | Bread | 1.4 | Bread | 1.4 |
| | Lettuce | 0.4 | Lettuce | 0.4 |
| | Mayonnaise | 0.2 | Mayonnaise | 0.4 |
| | Canned pears | 4.1 | Applesauce | 3.5 |
| | Molasses cookies | 0.5 | Milk | 7.0 |
| | Milk | 5.3 | | |
| Snack | Coconut cookies | 2.1 | Raisins | 0.9 |
| Dinner | Beef roast | 0.9 | Baked ham | 1.8 |
| | Gravy | 0.7 | Potato | 1.8 |
| | Potato | 1.8 | Green lima beans | 2.6 |
| | Margarine | 0.2 | Gingerbread | 1.4 |
| | Green asparagus | 1.8 | Hard sauce | 0.7 |
| | Vanilla ice cream | 2.8 | Margarine | 0.4 |
| | Chocolate syrup | 0.7 | Milk | 7.0 |
| | Milk | 7.0 | | |
| Other | Gelatin in ade | 0.4 | Sugar in ade | 3.5 |
| | Sugar in ade | 4.4 | Margarine | 0.4 |
| | Margarine | 0.4 | | |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 3.2 | Orange juice | 4.2 |
| | Wheat flakes | 0.7 | Ralston | 0.9 |
| | Dark brown sugar | 0.7 | Dates | 1.4 |
| | Cream | 1.1 | Dark brown sugar | 0.5 |
| | Bread | 0.7 | Jelly | 0.4 |
| | Margarine | 0.2 | Bread | 0.7 |
| | Milk | 7.0 | Margarine | 0.2 |
| | | | Milk | 7.0 |
| Snack | Graham crackers | 0.2 | Graham crackers | 0.2 |
| | | | Peanut butter | 0.4 |
| Lunch | Prune juice | 3.5 | Cheese food | 1.0 |
| | Cheese food | 0.5 | Bread | 1.4 |
| | Bread | 1.4 | Lettuce | 0.4 |
| | Lettuce | 0.4 | Mayonnaise | 0.2 |
| | Mayonnaise | 0.2 | Canned plums | 3.5 |
| | Yellow cake | 1.1 | Milk | 5.3 |
| | Frosting | 0.5 | | |
| | Milk | 5.3 | | |
| Snack | Graham crackers | 0.2 | Graham crackers | 0.2 |
| Dinner | Ground beef | 1.8 | Baked ham | 1.9 |
| | Potato | 3.5 | Potato | 1.8 |
| | Green peas | 2.1 | Snap beans | 1.4 |
| | Vanilla ice cream | 2.1 | Canned apricots | 3.5 |
| | Bread | 0.4 | Butter cookies | 2.1 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Milk | 7.0 | Milk | 7.0 |
| Other | Gelatin in ade | 0.2 | Sugar in ade | 3.3 |
| | Sugar in ade | 3.6 | | |
| | Pineapple juice | 0.4 | | |
| | Margarine | 0.5 | | |

Table 5. Kinds and amounts of food served in Diet 5; protein content: calculated - 88.6 grams per day; analyzed - 88.2 grams per day.

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Orange juice | 4.2 | Orange juice | 1.8 |
| | Cornflakes | 0.7 | Pineapple juice | 4.2 |
| | Dark brown sugar | 0.5 | Egg | 1.6 |
| | Apple butter | 0.7 | Bread | 0.7 |
| | Bread | 0.7 | Margarine | 0.2 |
| | Margarine | 0.2 | Milk | 5.3 |
| | Milk | 7.0 | | |
| Snack | Raisins | 0.9 | Graham crackers | 0.5 |
| Lunch | Chicken | 1.8 | Tomato soup | 2.1 |
| | Raw carrots | 0.4 | Tuna fish | 1.1 |
| | Bread | 1.4 | Bread | 1.4 |
| | Lettuce | 0.4 | Lettuce | 0.4 |
| | Mayonnaise | 0.2 | Mayonnaise | 0.4 |
| | Canned pears | 4.1 | Applesauce | 3.5 |
| | Molasses cookies | 0.5 | Sugar wafers | 2.1 |
| | Milk | 5.3 | Milk | 7.0 |
| Snack | Coconut cookies | 1.1 | Raisins | 0.9 |
| Dinner | Beef roast | 2.8 | Baked ham | 2.6 |
| | Gravy | 0.7 | Potato | 1.8 |
| | Potato | 1.8 | Green lima beans | 3.5 |
| | Green asparagus | 1.8 | Gingerbread | 1.4 |
| | Vanilla ice cream | 2.8 | Bread | 0.4 |
| | Margarine | 0.2 | Margarine | 0.4 |
| | Milk | 7.0 | Milk | 7.0 |
| Other | Gelatin in ade (powder base) | 0.7 | Gelatin in ade (powder base) | 0.6 |
| | Sugar in ade (powder base) | 2.7 | Sugar in ade (powder base) | 1.9 |
| | Margarine | 0.4 | Pineapple juice | 1.2 |
| | Pineapple juice | 1.3 | | |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 3.2 | Orange juice | 4.2 |
| | Wheat flakes | 0.7 | Ralston | 0.9 |
| | Dark brown sugar | 0.5 | Dates | 1.4 |
| | Cream | 1.1 | Dark brown sugar | 0.5 |
| | Egg | 1.8 | Jelly | 0.4 |
| | Bread | 0.7 | Bread | 0.7 |
| | Margarine | 0.2 | Margarine | 0.2 |
| | Milk | 7.0 | Milk | 7.0 |
| Snack | Graham crackers | 0.5 | Graham crackers | 0.2 |
| Lunch | Prune juice | 3.5 | Cheese food | 1.0 |
| | Cheese food | 1.2 | Chicken | 1.6 |
| | Bread | 1.4 | Bread | 1.4 |
| | Lettuce | 0.4 | Lettuce | 0.4 |
| | Mayonnaise | 0.2 | Mayonnaise | 0.2 |
| | Canned peaches | 2.5 | Canned plums | 3.5 |
| | Milk | 5.3 | Milk | 5.3 |
| Snack | Bread | 0.7 | Graham crackers | 0.2 |
| | Peanut butter | 0.5 | | |
| Dinner | Ground beef | 1.8 | Baked ham | 2.3 |
| | Potato | 2.6 | Potato | 1.8 |
| | Green peas | 2.1 | Snap beans | 1.4 |
| | Vanilla ice cream | 2.1 | Canned apricots | 3.5 |
| | Coconut cookies | 1.1 | Butter cookies | 1.1 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Milk | 7.0 | Milk | 7.0 |
| Other | Gelatin in ade (powder base) | 0.6 | Gelatin in ade (powder base) | 0.8 |
| | Sugar in ade (powder base) | 2.6 | Sugar in ade (powder base) | 3.5 |
| | Margarine | 0.2 | Pineapple juice | 1.6 |
| | Pineapple juice | 1.2 | | |

Table 6. Kinds and amounts of food served in Diet 6; protein content: calculated - 37.2 grams per day; analyzed - 39.1 grams per day.

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Pineapple juice | 4.2 | Orange juice | 4.2 |
| | Cornflakes | 0.5 | Rice Krispies | 1.0 |
| | Dark brown sugar | 0.7 | Dark brown sugar | 0.7 |
| | Jelly | 0.7 | Bread | 0.7 |
| | Bread | 0.7 | Margarine | 0.4 |
| | Margarine | 0.4 | Milk | 7.8 |
| | Milk | 7.8 | | |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Graham crackers | 0.5 | Fondant | 0.7 |
| | Fondant | 0.7 | | |
| Lunch | Tomato soup | 2.1 | Prune juice | 3.5 |
| | Tuna fish | 0.7 | Cheese food | 0.5 |
| | Mayonnaise | 0.5 | Mayonnaise | 0.5 |
| | Lettuce | 0.5 | Lettuce | 0.5 |
| | Applesauce | 3.5 | Canned peaches | 2.5 |
| | Bread | 1.4 | Bread | 1.4 |
| | Milk | 7.8 | Milk | 7.8 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Raisins | 0.9 | Molasses cookies | 0.5 |
| | Fondant | 0.7 | Fondant | 1.8 |
| Dinner | Baked ham | 0.5 | Ground beef | 0.5 |
| | Potato | 1.8 | Potato | 0.5 |
| | Broccoli | 1.1 | Green peas | 1.4 |
| | Gingerbread | 0.9 | Vanilla ice cream | 1.8 |
| | Fondant | 1.1 | Margarine | 0.7 |
| | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Margarine | 0.7 | | |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 4.2 | Orange juice | 4.2 |
| | Puffed wheat | 0.4 | Rice Chex | 1.0 |
| | Dark brown sugar | 0.7 | Dark brown sugar | 0.7 |
| | Apple butter | 0.7 | Jelly | 1.1 |
| | Bread | 0.7 | Bread | 0.7 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Milk | 7.8 | Milk | 7.8 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Raisins | 0.9 | Graham crackers | 0.5 |
| | Fondant | 0.7 | Fondant | 0.7 |
| Lunch | Bouillon cube | 0.1 | Cheese food | 0.5 |
| | Liver sausage | 0.5 | Mayonnaise | 0.5 |
| | Margarine | 0.4 | Lettuce | 0.5 |
| | Lettuce | 0.5 | Canned plums | 3.5 |
| | Canned pears | 4.1 | Bread | 1.4 |
| | Bread | 1.4 | Milk | 7.8 |
| | Molasses cookies | 0.5 | | |
| | Milk | 7.8 | | |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Sugar cookies | 1.1 | Fondant | 1.8 |
| | Fondant | 1.8 | | |

**Table 6 — Continued**

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| Dinner | Beef roast | 0.5 | Pork roast | 0.7 |
| | Converted rice | 0.5 | Converted rice | 1.8 |
| | Gravy | 0.7 | Snap beans | 1.4 |
| | Potato | 1.8 | Canned apricots | 3.5 |
| | Raw cabbage | 1.8 | Dates | 0.7 |
| | Mayonnaise | 0.5 | Margarine | 0.7 |
| | Vanilla ice cream | 1.8 | Ade (powder base) | 0.5 |
| | Chocolate syrup | 1.1 | Sugar | 0.6 |
| | Margarine | 0.4 | | |
| | Ade (powder base) | 0.5 | | |
| | Sugar | 0.6 | | |
| | Day 5 | | Day 6 | |
| Breakfast | Orange juice | 1.8 | Orange juice | 4.2 |
| | Pineapple juice | 4.2 | Cornflakes | 0.9 |
| | Rice Krispies | 1.0 | Dark brown sugar | 0.7 |
| | Dark brown sugar | 0.7 | Apple butter | 0.7 |
| | Bread | 0.7 | Bread | 0.7 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Milk | 7.8 | Milk | 7.8 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Fondant | 0.7 | Raisins | 0.9 |
| | | | Fondant | 0.7 |
| Lunch | Tomato soup | 2.1 | Bouillon cube | 0.1 |
| | Salmon | 0.5 | Bologna | 0.7 |
| | Mayonnaise | 0.5 | Mayonnaise | 0.5 |
| | Lettuce | 0.5 | Lettuce | 0.5 |
| | Canned peaches | 2.5 | Raw carrots | 1.4 |
| | Molasses cookies | 0.5 | Canned pears | 4.1 |
| | Bread | 1.4 | Coconut cookies | 0.4 |
| | Milk | 7.8 | Bread | 1.4 |
| | | | Milk | 7.8 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Raisins | 0.9 | Fondant | 1.8 |
| | Fondant | 0.7 | | |
| Dinner | Beef roast | 0.4 | Pork roast | 0.7 |
| | Potato | 2.3 | Converted rice | 3.5 |
| | Green asparagus | 1.8 | Snap beans | 3.0 |
| | Fondant | 1.1 | Margarine | 1.1 |
| | Gingerbread | 1.4 | Yellow cake | 1.1 |
| | Margarine | 0.7 | Ade (powder base) | 0.5 |
| | Ade (powder base) | 0.5 | Sugar | 0.6 |
| | Sugar | 0.6 | | |

Table 7. Kinds and amounts of food served in Diet 7; protein content: calculated - 44.5 grams per day; analyzed - 44.8 grams per day.

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Pineapple juice | 4.2 | Orange juice | 4.2 |
| | Cornflakes | 0.9 | Rice Krispies | 1.0 |
| | Dark brown sugar | 0.7 | Dark brown sugar | 0.7 |
| | Jelly | 0.7 | Bread | 0.7 |
| | Bread | 0.7 | Margarine | 0.4 |
| | Milk | 10.9 | Milk | 10.9 |
| | Margarine | 0.4 | | |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Graham crackers | 0.5 | Fondant | 0.7 |
| | Fondant | 0.7 | | |
| Lunch | Tomato soup | 2.1 | Prune juice | 3.5 |
| | Tuna fish | 0.7 | Cheese food | 0.5 |
| | Mayonnaise | 0 5 | Mayonnaise | 0.5 |
| | Lettuce | 0.5 | Lettuce | 0.5 |
| | Applesauce | 3.5 | Canned peaches | 2.5 |
| | Bread | 1.4 | Bread | 1.4 |
| | Milk | 8.5 | Milk | 8.5 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Raisins | 0.9 | Molasses cookies | 0.5 |
| | Fondant | 0.7 | Fondant | 1.8 |
| Dinner | Baked ham | 0.7 | Ground beef | 1.1 |
| | Potato | 1.8 | Green peas | 1.8 |
| | Broccoli | 1.8 | Vanilla ice cream | 1.8 |
| | Gingerbread | 1.4 | Margarine | 0.7 |
| | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Fondant | 1.1 | | |
| | Margarine | 0.7 | | |
| | Day 3 | | Day 4 | |
| Breakfast | Orange juice | 4.2 | Orange juice | 4.2 |
| | Puffed wheat | 0.4 | Rice Chex | 1.0 |
| | Dark brown sugar | 0.7 | Dark brown sugar | 0.7 |
| | Apple butter | 0.7 | Jelly | 1.1 |
| | Bread | 0.7 | Bread | 0.7 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Milk | 10.9 | Milk | 10.9 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Raisins | 0.9 | Graham crackers | 0.5 |
| | Fondant | 0.7 | Fondant | 1.4 |
| Lunch | Bouillon cube | 0.1 | Cheese food | 0.7 |
| | Liver sausage | 0.5 | Mayonnaise | 0 5 |
| | Margarine | 0.4 | Lettuce | 0.5 |
| | Lettuce | 0.5 | Canned plums | 3.5 |
| | Canned pears | 4.1 | Bread | 1.4 |
| | Molasses cookies | 0 5 | Milk | 8.5 |
| | Bread | 1.4 | | |
| | Milk | 7.8 | | |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Sugar cookies | 1.1 | Fondant | 1.8 |
| | Fondant | 1.8 | | |

**Table 7 — Continued**

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| Dinner | Beef roast | 0.9 | Pork roast | 1.1 |
| | Gravy | 0.7 | Converted rice | 1.8 |
| | Potato | 1.8 | Snap beans | 1.4 |
| | Raw cabbage | 1.8 | Canned apricots | 3.5 |
| | Mayonnaise | 0.5 | Dates | 0.7 |
| | Vanilla ice cream | 1.8 | Margarine | 0.7 |
| | Chocolate syrup | 1.1 | Ade (powder base) | 0.5 |
| | Margarine | 0.4 | Sugar | 0.6 |
| | Ade (powder base) | 0.5 | | |
| | Sugar | 0.6 | | |
| | Day 5 | | Day 6 | |
| Breakfast | Orange juice | 1.8 | Orange juice | 4.2 |
| | Pineapple juice | 4.2 | Cornflakes | 0.9 |
| | Rice Krispies | 1.0 | Dark brown sugar | 0.7 |
| | Dark brown sugar | 0.7 | Apple butter | 0.7 |
| | Bread | 0.7 | Bread | 0.7 |
| | Margarine | 0.4 | Milk | 10.9 |
| | Milk | 10.9 | Margarine | 0.4 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Fondant | 1.4 | Raisins | 0.9 |
| | | | Fondant | 1.4 |
| Lunch | Tomato soup | 2.1 | Bouillon cube | 0.1 |
| | Salmon | 0.7 | Bologna | 0.9 |
| | Mayonnaise | 0.5 | Mayonnaise | 0.5 |
| | Lettuce | 0.5 | Lettuce | 0.5 |
| | Canned peaches | 2.5 | Raw carrots | 1.4 |
| | Molasses cookies | 0.5 | Canned pears | 4.1 |
| | Bread | 1.4 | Coconut cookies | 0.4 |
| | Milk | 8.5 | Bread | 1.4 |
| | | | Milk | 8.5 |
| Snack | Ade (powder base) | 0.5 | Ade (powder base) | 0.5 |
| | Sugar | 0.6 | Sugar | 0.6 |
| | Raisins | 0.9 | Fondant | 1.8 |
| | Fondant | 0.7 | | |
| Dinner | Beef roast | 0.7 | Pork roast | 1.4 |
| | Potato | 1.8 | Converted rice | 3.5 |
| | Green asparagus | 1.8 | Snap beans | 3.0 |
| | Gingerbread | 1.4 | Margarine | 1.1 |
| | Fondant | 1.1 | Yellow cake | 1.1 |
| | Margarine | 0.7 | Ade (powder base) | 0.5 |
| | Ade (powder base) | 0.5 | Sugar | 0.6 |
| | Sugar | 0.6 | | |

Table 8. Kinds and amounts of food served in Diet 8; protein content: calculated - 21.2 grams per day; analyzed - 22.1 grams per day.

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Day 1 | | Day 2 | |
| Breakfast | Orange juice | 4.2 | Orange juice | 4.2 |
| | Puffed rice | 0.5 | Rice Krispies | 0.6 |
| | Brown sugar | 0.7 | Brown sugar | 0.7 |
| | Apple Butter | 0.7 | Apple Butter | 0.7 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Bread | 0.7 | Bread | 0.7 |
| | Diluted coffee cream (2-1 water) | 4.2 | Diluted coffee cream (2-1 water) | 4.2 |
| Snack | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Graham crackers | 0.2 | Sugar | 0.4 |
| | Fondant | 0.7 | Applesauce cookies | 0.5 |
| | Sugar | 0.4 | Fondant | 0.7 |
| Lunch | Bread | 1.4 | Prune juice | 3.5 |
| | Mayonnaise | 0.5 | Bread | 1.4 |
| | Lettuce | 0.5 | Mayonnaise | 0.5 |
| | Margarine | 0.4 | Lettuce | 0.5 |
| | Liver cheese | 0.4 | Margarine | 0.4 |
| | Milk | 4.2 | Sliced pineapple | 1.8 |
| | Canned apricots | 3.5 | Raw carrots | 0.2 |
| | Ade (powder base) | 0.2 | Milk | 4.2 |
| | Brown sugar | 0.5 | Canned peaches | 2.5 |
| | Sugar | 0.4 | Ade (powder base) | 0.2 |
| | | | Brown sugar | 0.5 |
| | | | Sugar | 0.4 |
| Snack | Molasses cookie | 0.5 | Ade (powder base) | 0.2 |
| | Ade (powder base) | 0.2 | Brown sugar | 0.5 |
| | Brown sugar | 0.5 | Sugar | 0.4 |
| | Sugar | 0.4 | Fondant | 0.7 |
| | Fondant | 0.7 | | |
| Dinner | Beef roast | 0.4 | Ground beef | 0.5 |
| | Potato | 2.3 | Potato | 2.3 |
| | Summer squash | 1.8 | Green asparagus | 1.8 |
| | Plain cake | 1.8 | Grape juice tapioca | 3.5 |
| | Margarine | 0.7 | Margarine | 0.7 |
| | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Sugar | 0.4 | Sugar | 0.4 |
| Snack | Fondant | 0.7 | Fondant | 0.7 |
| | Day 3 | | Day 4 | |
| Breakfast | Pineapple juice | 2.8 | Pineapple juice | 2.8 |
| | Orange juice | 1.4 | Orange juice | 1.4 |
| | Rice Chex | 1.0 | Cornflakes | 0.5 |
| | Brown sugar | 0.7 | Brown sugar | 0.7 |
| | Diluted coffee cream (2-1 water) | 4.2 | Diluted coffee cream (2-1 water) | 4.2 |
| | Jelly | 0.7 | Jelly | 0.7 |
| | Margarine | 0.4 | Margarine | 0.4 |
| | Bread | 0.7 | Bread | 0.7 |
| Snack | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Sugar | 0.4 | Sugar | 0.4 |
| | Graham crackers | 0.2 | Raisins | 0.7 |
| | Fondant | 0.7 | Fondant | 0.7 |
| Lunch | Bread | 1.4 | Asparagus soup | 2.1 |
| | Mayonnaise | 0.2 | Bread | 1.4 |
| | Lettuce | 0.5 | Margarine | 0.7 |
| | Banana | 1.8 | Mayonnaise | 0.5 |
| | Milk | 4.2 | Lettuce | 0.5 |
| | Canned plums | 3.5 | Tomato | 1.4 |
| | Margarine | 0.4 | Milk | 4.2 |

**Table 8 — Continued**

| Meal | Food | Weight, ounces | Food | Weight, ounces |
|---|---|---|---|---|
| | Ade (powder base) | 0.2 | Applesauce | 3.5 |
| | Brown sugar | 0.5 | Ade (powder base) | 0.2 |
| | Sugar | 0.4 | Brown sugar | 0.5 |
| | | | Sugar | 0.4 |
| Snack | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Sugar | 0.4 | Sugar | 0.4 |
| | Fondant | 0.7 | Fondant | 0.7 |
| Dinner | Ground beef | 0.4 | Baked ham | 0.5 |
| | Tomato catsup | 0.4 | Potato | 2.3 |
| | Converted rice | 2.5 | Broccoli | 0.9 |
| | Raw cabbage | 1.8 | Pineapple tapioca | 3.5 |
| | Raw carrots | 0.2 | Margarine | 0.4 |
| | Mayonnaise | 0.4 | Ade (powder base) | 0.2 |
| | Snap beans | 1.1 | Brown sugar | 0.5 |
| | Canned pears | 3.5 | Sugar | 0.4 |
| | Margarine | 0.7 | | |
| | Ade (powder base) | 0.2 | | |
| | Brown sugar | 0.5 | | |
| | Sugar | 0.4 | | |
| Snack | Fondant | 0.7 | Fondant | 0.7 |
| | Day 5 | | Day 6 | |
| Breakfast | Pineapple juice | 4.2 | Orange juice | 4.2 |
| | Orange juice | 1.4 | Cornflakes | 0.5 |
| | Rice Krispies | 0.6 | Brown sugar | 0.7 |
| | Brown sugar | 0.7 | Diluted coffee cream (2-1 water) | 4.2 |
| | Diluted coffee cream (2-1 water) | 4.2 | Jelly | 0.7 |
| | Jelly | 0.7 | Margarine | 0.4 |
| | Margarine | 0.4 | Bread | 0.7 |
| | Bread | 0.7 | | |
| Snack | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Sugar | 0.4 | Sugar | 0.4 |
| | Molasses cookie | 0.5 | Raisins | 0.7 |
| | Fondant | 0.7 | Fondant | 0.7 |
| Lunch | Tomato soup | 2.1 | Celery soup | 2.1 |
| | Bread | 1.4 | Bread | 1.4 |
| | Margarine | 0.7 | Margarine | 0.7 |
| | Mayonnaise | 0.5 | Mayonnaise | 0.5 |
| | Lettuce | 0.5 | Lettuce | 0.5 |
| | Sliced pineapple | 1.8 | Tomato | 1.4 |
| | Milk | 4.2 | Milk | 4.2 |
| | Canned peaches | 2.5 | Canned pears | 3.5 |
| | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Sugar | 0.4 | Sugar | 0.4 |
| Snack | Ade (powder base) | 0.2 | Ade (powder base) | 0.2 |
| | Brown sugar | 0.5 | Brown sugar | 0.5 |
| | Sugar | 0.4 | Sugar | 0.4 |
| | Fondant | 0.7 | Fondant | 0.7 |
| Dinner | Beef roast | 0.5 | Pork roast | 0.5 |
| | Potato | 2.3 | Potato | 1.8 |
| | Snap beans | 1.8 | Raw carrots | 0.2 |
| | Raspberry sherbet | 3.5 | Cinnamon apple | 3.5 |
| | Margarine | 0.4 | Banana sherbet | 3.5 |
| | Ade (powder base) | 0.2 | Margarine | 0.4 |
| | Brown sugar | 0.5 | Ade (powder base) | 0.2 |
| | Sugar | 0.4 | Brown sugar | 0.5 |
| | | | Sugar | 0.4 |
| Snack | Fondant | 0.7 | Fondant | 0.7 |

of each amino acid for all subjects on each diet. The number of subjects fed each diet, and the number of days that the diets were analyzed, varied with the particular study. The mean daily intakes of amino acids, reported in Table 11, were averaged from the number of subjects and days listed below:

| Diet | Number of Girls | Number of Days |
|---|---|---|
| 1 | 11 | 32 |
| 2 | 3 | 28 |
| 3 | 3 | 28 |
| 4 | 3 | 28 |
| 5 | 3 | 28 |
| 6 | 6 | 24 |
| 7 | 4 | 24 |
| 8 | 13 | 48 |

Minimum daily requirements of preadolescent girls for the essential amino acids have not been determined. However, the minimum amounts required by certain other groups are known. Comparison of the intake for girls fed the experimental diets with some of these known requirements can give us a rough idea about the adequacy of the experimental diets. Table 11 shows such a comparison with minimum requirements for young adult men and women and school age children (11 to 14 year old boys).

Diets 1, 3, 4, and 5 are found to contain more of all of the essential amino acids than the minimum daily requirements of young men, young women and 11 to 14 year old boys. These four diets contained the largest amounts of protein. Diets 2, 6, 7 and 8 contain more of the essential amino acids than are required by young adult women. However, none of these diets contained as much methionine as is required by young adult men. Even though Diet 2 provided only

Table 9. Amino acid content of milk used with diet 8.

| Amino Acid | Milk | |
|---|---|---|
| | Skim | Whole homogenized |
| | g/100 g protein (16 g nitrogen) | |
| arginine | 2.98 | 3.55 |
| histidine | 3.02 | 3.15 |
| isoleucine | 6.15 | 6.14 |
| leucine | 9.32 | 9.61 |
| lysine | 8.72 | 8.54 |
| methionine | 2.85 | 2.85 |
| phenylalanine | 4.86 | 5.21 |
| threonine | 4.34 | 3.85 |
| valine | 8.15 | 7.09 |

Table 10. Comparison of essential amino acid content of Experimental diets with FAO reference pattern.

| | FAO | Diets: 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 (without milk) |
|---|---|---|---|---|---|---|---|---|---|
| Amino Acid | | | | | g/100 g protein | | | | |
| Isoleucine | 4.2 | 5.39 | 5.60 | 5.43 | 5.65 | 5.65 | 5.20 | 5.50 | 4.61 |
| Leucine | 4.8 | 8.17 | 8.81 | 8.52 | 7.93 | 7.50 | 7.18 | 7.56 | 6.94 |
| Lysine | 4.2 | 6.70 | 6.09 | 6.64 | 6.19 | 7.04 | 5.60 | 6.71 | 5.37 |
| Methionine | 2.2 | 2.09 | 2.12 | 2.19 | 2.03 | 2.18 | 1.87 | 1.89 | 2.10 |
| Phenylalanine | 2.8 | 4.26 | 4.49 | 4.28 | 3.98 | 4.06 | 4.15 | 4.29 | 4.29 |
| Threonine | 2.8 | 4.15 | 4.10 | 4.01 | 3.94 | 3.79 | 3.68 | 3.86 | 3.30 |
| Tryptophan | 1.4 | 1.18 | ...... | ...... | ...... | ...... | 1.16 | 1.21 | ...... |
| Valine | 4.2 | 5.89 | 5.75 | 5.91 | 5.66 | 5.76 | 6.17 | 6.10 | 5.62 |

Table 11. A comparison of mean daily intake of amino acids, in grams, for subjects on experimental diets, with minimum daily requirements.

| Amino Acid | Minimum Daily Requirements Young Adult Men | Young Adult Women | 11-14 year old Children (boys) | Diet 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Isoleucine | 0.7 | 0.4 | 1.0 | 3.46 | 2.68 | 3.97 | 3.35 | 5.04 | 2.00 | 2.52 | 0.99 |
| Leucine | 1.1 | 0.6 | 1.5 | 5.26 | 4.21 | 6.23 | 4.72 | 6.68 | 2.76 | 3.47 | 1.49 |
| Lysine | 0.8 | 0.5 | 1.6 | 4.34 | 2.91 | 4.85 | 3.69 | 6.28 | 2.16 | 3.08 | 1.23 |
| Methionine | 1.1 | 0.4 | 0.8 | 1.34 | 1.02 | 1.60 | 1.21 | 1.95 | 0.72 | 0.87 | 0.45 |
| Phenylalanine | 1.1 | 0.8 | | 2.76 | 2.15 | 3.13 | 2.37 | 3.62 | 1.60 | 1.97 | 0.90 |
| Threonine | 0.5 | 0.3 | | 2.67 | 1.97 | 2.93 | 2.34 | 3.38 | 1.42 | 1.77 | 0.69 |
| Tryptophan | 0.3 | 0.2 | | 0.77 | ..... | ..... | ..... | ..... | 0.45 | 0.56 | ..... |
| Valine | 0.8 | 0.6 | | 3.78 | 2.75 | 4.32 | 3.35 | 5.13 | 2.37 | 2.80 | 1.19 |

slightly more protein per day than Diet 7 (48 grams versus 45 grams), Diet 2 contained considerably more methionine. Diet 8 contained less phenylalanine than is required by young adult men. When the amounts of essential amino acids required by 11 to 14 year old boys are used as criteria of adequacy, Diets 2 and 7 are found to contain an adequate amount of methionine. Diet 8, however, then is found to be low in methionine and lysine and borderline regarding leucine and isoleucine content.

Although use of the above criteria cannot be considered exact, the diets meeting these criteria can be considered more likely to be adequate in regard to supply of essential amino acids for preadolescent girls. Therefore, parents will be most interested in the diets most likely to provide adequate amounts of amino acids. These are Diets 1, 3, 4 and 5. The menus making up these diets are not proposed as fixed or recommended patterns for meals in the home. However, a study of the kinds and amounts of foods provided by them should give the meal planner some ideas for a general type of diet which can provide adequate protein nutrition. The protein contents of these four diets ranged from slightly less than, to more protein than the 60 grams recommended by the National Research Council for 7 to 9 year old girls.

## SUMMARY AND CONCLUSIONS

Most of us are fortunate enough to have an adequate supply of food for our daily needs. In fact, to most of us, the idea of nutritional deficiencies is a thing of the past, or, at least, something that may occur in other countries, but not in ours. The most serious nutrition problems found in the United States are, after all, related to excessive intake of nutrients, rather than to deficient intake.

The facts do not entirely support the above ideas, however. It is true that serious protein deficiency in the diets of young children occurs much less often in this country than in some other parts of the world. But, borderline, or slight, deficiencies of protein may occur fairly frequently in young children in this country. Such a deficiency results in irritability, lowered resistance to infectious diseases, poor appetite and failure to gain weight. This sort of deficiency arises largely because parents of young children do not recognize the important relationship between protein and other nutrients in the diet and overall health of the child.

Protein is a very important foodstuff. It supplies amino acids which the body uses to manufacture and maintain its own protein supply. When the raw materials are not present in the daily diet, the efficiency of protein manufacture is lowered. Analysis of the whole diet for total content of amino acids can tell us whether the food we eat is supplying each of the essential amino acids in adequate amounts for efficient protein synthesis.

## APPENDIX

### A. Methods

Variable weights of composited food samples were used for amino acid assay. Tryptophan was analyzed in Diet 1, using a weight of food sample corresponding to 1 gram of protein, and in Diets 6 and 7, using a weight of food sample corresponding to 0.25 grams of protein. All other amino acids were analyzed using weights of food samples corresponding to 100 milligrams of protein from Diets 1, 2, 3, 4 and 5 and to 50 milligrams of protein from Diets 6, 7 and 8.

Analyses for tryptophan were made using the colorimetric method of Horn and Jones (14). Cystine was analyzed by the method of Horn and Blum (13). All other amino acids were analyzed by the method of Horn, Jones and Blum (15), using the modifications suggested later by Horn **et al.** (11, 12). Assays were conducted using the following microorganisms: **Leuconostoc mesenteroides** for cystine, lysine, histidine, leucine, phenylalanine, isoleucine and methionine; and **Streptococcus faecalis** for arginine, threonine and valine.

Composited food samples for the microbiological assay of cystine were hydrolyzed by refluxing for two hours with 22 percent hydrochloric acid. Samples for assay of all other amino acids were hydrolyzed by refluxing for 24 hours with 22 percent hydrochloric acid.

The amount of hydrolyzate used for each amino acid assay was based on a standard curve of growth response of the microorganism to known amounts of the various amino acids. Recoveries of amino acids added to the food samples before hydrolysis were considered accurate enough that no correction factors were necessary in calculations of amounts of amino acids present.

### B. Tables

**Appendix Table 1.** **Amino acid content of diet 1 in grams per 100 grams of protein (16 grams of nitrogen).**

| Period | Location | Arginine | Cystine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenyl-alanine | Threonine | Tryptophan | Valine |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Tenn | 4.86 | 1.58 | 2.80 | 5.52 | 8.31 | 6.80 | 2.15 | 4.43 | 4.15 | 1.12 | 5.72 |
| 4 | Tenn. | 4.37 | 1.58 | 2.75 | 5.41 | 8.20 | 6.76 | 2.09 | 4.28 | 4.30 | 1.14 | 5.98 |
| 6 | Tenn. | 5.04 | 1.57 | 3.00 | 5.71 | 8.71 | 6.66 | 2.09 | 4.44 | 4.19 | 1.24 | 5.97 |
| 8 | Tenn. | 4.56 | 1.63 | 2.82 | 5.52 | 8.26 | 6.45 | 2.01 | 4.65 | 4.18 | 1.18 | 5.60 |
| 10 | Tenn. | 4.76 | 1.68 | 2.54 | 5.22 | 7.80 | 6.54 | 1.87 | 4.25 | 3.84 | 1.20 | 5.45 |
| 12 | Tenn. | 4.82 | 1.39 | 3.29 | 5.51 | 8.78 | 7.98 | 2.41 | 4.71 | 4.19 | 1.14 | 6.29 |
| 14 | Tenn. | 4.93 | 1.37 | 2.73 | 5.67 | 8.38 | 6.45 | 2.14 | 4.15 | 4.11 | 1.18 | 5.99 |
| 16 | Tenn. | 4.69 | 1.68 | 2.60 | 5.71 | 8.54 | 6.54 | 2.15 | 4.06 | 4.19 | 1.18 | 6.09 |
| 2 | La. | 4.59 | 1.44 | 2.66 | 5.14 | 8.10 | 6.42 | 1.91 | 4.27 | 4.02 | 1.26 | 5.50 |
| 4 | La. | 4.22 | 1.58 | 2.51 | 5.10 | 7.77 | 6.20 | 2.07 | 4.10 | 4.06 | 1.21 | 5.70 |
| 6 | La. | 3.99 | 1.44 | 2.58 | 5.10 | 7.47 | 6.16 | 2.13 | 3.75 | 4.14 | 1.13 | 5.67 |
| 8 | La. | 4.63 | 1.60 | 2.53 | 5.72 | 7.94 | 6.65 | 2.02 | 4.14 | 4.06 | 1.16 | 5.99 |
| 10 | La. | 4.47 | 1.65 | 2.65 | 5.38 | 8.14 | 7.06 | 2.04 | 4.13 | 4.16 | 1.23 | 5.48 |
| 12 | La. | 4.42 | 1.66 | 2.78 | 5.14 | 8.11 | 7.09 | 2.21 | 4.33 | 4.52 | 1.20 | 5.54 |
| 14 | La. | 4.43 | 1.43 | 2.92 | 5.12 | 8.00 | 6.93 | 2.09 | 4.41 | 4.20 | 1.18 | 6.12 |
| 16 | La. | 4.60 | 1.47 | 3.03 | 5.22 | 8.26 | 6.55 | 2.08 | 4.05 | 4.10 | 1.20 | 6.18 |
|  | Mean: | 4.58 | 1.65 | 2.76 | 5.39 | 8.17 | 6.70 | 2.09 | 4.26 | 4.15 | 1.18 | 5.89 |
|  | S. D. | .34 | .11 | .21 | .24 | .34 | .43 | .12 | .24 | .14 | .04 | .03 |

**Appendix Table 2.** **Amino acid content of diet 2 in grams per 100 grams of protein (16 grams of nitrogen).**

| Period | Arginine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenyl-alanine | Threonine | Valine |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 4.15 | 2.67 | 5.54 | 8.61 | 6.13 | 2.11 | 4.57 | 3.97 | 5.91 |
| 4 | 4.20 | 2.66 | 5.68 | 8.88 | 6.14 | 2.26 | 4.56 | 4.05 | 5.78 |
| 6 | 4.08 | 2.68 | 5.48 | 8.69 | 6.03 | 2.25 | 4.59 | 4.27 | 5.76 |
| 8 | 4.15 | 2.76 | 5.45 | 8.77 | 6.11 | 1.98 | 4.31 | 4.02 | 5.81 |
| 10 | 3.94 | 2.72 | 5.48 | 8.81 | 6.28 | 2.08 | 4.55 | 4.08 | 5.63 |
| 12 | 4.00 | 2.78 | 5.78 | 9.02 | 5.81 | 2.05 | 4.44 | 4.17 | 5.63 |
| 14 | 3.94 | 2.81 | 5.77 | 8.90 | 6.11 | 2.10 | 4.43 | 4.15 | 5.74 |
| Mean: | 4.06 | 2.73 | 5.60 | 8.81 | 6.09 | 2.12 | 4.49 | 4.10 | 5.75 |
| S. D. | .11 | .07 | .14 | .14 | .15 | .10 | .10 | .10 | .10 |

Appendix Table 3. Amino acid content of diet 3 in grams per 100 grams of protein (16 grams of nitrogen).

| Period | Arginine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenyl-alanine | Threonine | Valine |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 5.20 | 2.81 | 5.25 | 8.47 | 6.61 | 2.36 | 4.21 | 3.99 | 5.97 |
| 4 | 5.44 | 2.79 | 5.59 | 8.54 | 6.72 | 2.33 | 4.24 | 4.16 | 5.88 |
| 6 | 5.18 | 2.81 | 5.35 | 8.46 | 6.73 | 2.23 | 4.36 | 4.01 | 5.95 |
| 8 | 4.94 | 2.69 | 5.31 | 8.29 | 6.42 | 2.13 | 4.26 | 3.96 | 5.68 |
| 10 | 5.05 | 2.75 | 5.49 | 8.56 | 6.63 | 1.98 | 4.24 | 3.98 | 5.77 |
| 12 | 5.31 | 2.76 | 5.60 | 8.73 | 6.66 | 2.11 | 4.35 | 4.01 | 6.14 |
| 14 | 5.20 | 2.71 | 5.40 | 8.60 | 6.69 | 2.19 | 4.33 | 3.94 | 5.96 |
| Mean: | 5.19 | 2.76 | 5.43 | 8.52 | 6.64 | 2.19 | 4.28 | 4.01 | 5.91 |
| S. D. | .16 | .05 | .34 | .14 | .11 | .13 | .07 | .07 | .15 |

Appendix Table 4. Amino acid content of diet 4 in grams per 100 grams of protein (16 grams of nitrogen).

| Period | Arginine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenyl-alanine | Threonine | Valine |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 5.38 | 2.67 | 5.57 | 7.95 | 6.22 | 2.18 | 3.90 | 3.92 | 5.70 |
| 4 | 5.26 | 2.58 | 5.67 | 8.02 | 6.17 | 1.90 | 3.97 | 4.00 | 5.56 |
| 6 | 5.39 | 2.74 | 5.70 | 8.07 | 6.13 | 1.99 | 4.08 | 4.11 | 5.78 |
| 8 | 5.32 | 2.55 | 5.56 | 7.82 | 6.04 | 1.99 | 3.92 | 3.88 | 5.78 |
| 10 | 5.21 | 2.57 | 5.76 | 7.88 | 6.48 | 2.02 | 3.94 | 3.81 | 5.53 |
| 12 | 5.43 | 2.72 | 5.74 | 7.92 | 6.23 | 2.15 | 4.05 | 3.90 | 5.61 |
| 14 | 5.44 | 2.54 | 5.56 | 7.83 | 6.23 | 2.01 | 3.97 | 3.96 | 5.69 |
| Mean: | 5.35 | 2.62 | 5.65 | 7.93 | 6.19 | 2.03 | 3.98 | 3.94 | 5.66 |
| S. D. | .09 | .08 | .09 | .09 | .13 | .09 | .07 | .10 | .10 |

Appendix Table 5. Amino acid content of diet 5 in grams per 100 grams of protein (16 grams of nitrogen).

| Period | Arginine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenyl-alanine | Threonine | Valine |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 5.74 | 2.35 | 5.66 | 7.70 | 7.09 | 2.16 | 4.10 | 3.76 | 5.68 |
| 4 | 5.93 | 2.26 | 5.42 | 7.38 | 6.70 | 2.24 | 4.01 | 3.72 | 5.86 |
| 6 | 5.91 | 2.37 | 5.62 | 7.60 | 7.14 | 2.06 | 4.06 | 3.77 | 5.95 |
| 8 | 5.58 | 2.30 | 5.58 | 7.39 | 6.95 | 2.22 | 4.04 | 3.79 | 5.66 |
| 10 | 5.60 | 2.33 | 5.69 | 7.44 | 7.16 | 2.14 | 4.05 | 3.85 | 5.62 |
| 12 | 6.21 | 2.42 | 5.76 | 7.55 | 7.22 | 2.33 | 4.14 | 3.91 | 5.83 |
| 14 | 6.11 | 2.34 | 5.83 | 7.41 | 7.02 | 2.13 | 4.06 | 3.75 | 5.70 |
| Mean: | 5.87 | 2.34 | 5.65 | 7.50 | 7.04 | 2.18 | 4.06 | 3.79 | 5.76 |
| S. D. | .24 | .05 | .13 | .12 | .17 | .09 | .04 | .07 | .12 |

**Appendix Table 6. Amino acid content of diet 6 in grams per 100 grams of protein (16 grams of nitrogen)**

| Period | Arginine | Cystine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenylalanine | Threonine | Tryptophan | Valine |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4.92 | 1.17 | 2.82 | 5.30 | 7.08 | 5.53 | 1.94 | 4.26 | 3.87 | 1.04 | 6.43 |
| 3 | 5.18 | 1.02 | 2.75 | 4.98 | 7.24 | 5.45 | 1.82 | 4.02 | 3.62 | 1.22 | 6.14 |
| 4 | 5.47 | 1.15 | 2.97 | 5.27 | 7.41 | 5.92 | 1.94 | 4.16 | 3.66 | 1.22 | 6.46 |
| 5 | 5.94 | 0.93 | 2.78 | 5.23 | 7.01 | 5.50 | 1.78 | 4.17 | 3.57 | 1.18 | 5.65 |
| Mean: | 5.38 | 1.07 | 2.83 | 5.20 | 7.18 | 5.60 | 1.87 | 4.15 | 3.68 | 1.16 | 6.17 |
| S. D. | .14 | .12 | .08 | .15 | .11 | .22 | .08 | .10 | .13 | .08 | .12 |

**Appendix Table 7. Amino acid content of diet 7 in grams per 100 grams of protein (16 grams of nitrogen).**

| Period | Arginine | Cystine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenylalanine | Threonine | Tryptophan | Valine |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 5.44 | 1.20 | 2.62 | 5.49 | 7.50 | 6.24 | 2.06 | 4.27 | 3.99 | 1.12 | 6.59 |
| 3 | 4.78 | 1.00 | 2.92 | 5.53 | 7.66 | 6.57 | 1.88 | 4.31 | 3.68 | 1.25 | 6.07 |
| 4 | 5.23 | 1.20 | 2.57 | 5.62 | 7.58 | 6.95 | 1.88 | 4.41 | 4.08 | 1.24 | 5.96 |
| 5 | 5.32 | 1.01 | 2.17 | 5.36 | 7.49 | 7.08 | 1.74 | 4.17 | 3.69 | 1.24 | 5.76 |
| Mean: | 5.19 | 1.10 | 2.57 | 5.50 | 7.56 | 6.71 | 1.89 | 4.29 | 3.86 | 1.21 | 6.10 |
| S. D. | .29 | .11 | .30 | .11 | .08 | .12 | .13 | .10 | .20 | .05 | .11 |

**Appendix Table 8. Amino acid content of diet 8 (without milk) in grams per 100 grams of protein (16 grams of nitrogen).**

| Period | Arginine | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenylalanine | Threonine | Valine |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.91 | 2.29 | 4.64 | 7.03 | 5.55 | 1.93 | 4.11 | 3.37 | 6.17 |
| 2 | 4.42 | 2.36 | 4.69 | 6.90 | 5.50 | 2.14 | 4.06 | 3.28 | 5.94 |
| 3 | 4.16 | 2.62 | 4.79 | 7.09 | 5.38 | 2.21 | 4.25 | 3.59 | 5.98 |
| 4 | 3.96 | 2.41 | 4.52 | 6.36 | 5.10 | 2.14 | 4.24 | 3.28 | 5.39 |
| 5 | 4.15 | 2.56 | 4.76 | 6.74 | 5.48 | 2.22 | 4.49 | 3.42 | 5.48 |
| 6 | 4.70 | 2.40 | 4.43 | 6.92 | 5.37 | 2.02 | 4.34 | 3.25 | 5.56 |
| 7 | 5.03 | 2.53 | 4.62 | 7.54 | 5.40 | 2.08 | 4.46 | 3.02 | 5.42 |
| 8 | 4.71 | 2.53 | 4.42 | 6.91 | 5.17 | 2.04 | 4.36 | 3.18 | 5.00 |
| Mean: | 4.50 | 2.46 | 4.61 | 6.94 | 5.37 | 2.10 | 4.29 | 3.30 | 5.62 |
| S. D. | .12 | .27 | .14 | .10 | .15 | .09 | .15 | .13 | .12 |

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# Milk, Ice Cream, And Competing Beverages and Desserts

By

Dorothy Dickins

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# MILK, ICE CREAM, AND COMPETING BEVERAGES AND DESSERTS

By

Dorothy Dickins

## INTRODUCTION

The purpose of this report is to present some recent findings concerning use of milk and ice cream and other beverages and desserts by members of 517 white and 291 Negro urban families in four Mississippi cities (Meridian, Clarksdale, Picayune, and Winona).

Specifically, white and Negro homemakers were asked to give the usual beverage drunk by each family member at breakfast, noon meal, evening meal, and between meals in warm and cold weather. Also, they were asked about the desserts they used most frequently and the desserts their family liked best.

Responses to these questions were analyzed by several variables in an attempt to determine what factors were related to practices with respect to beverages and desserts. These variables include race, income, food costs per person per meal, family size, age, education and home background of male heads of households and homemakers, and employment of homemakers.

## DESCRIPTION OF FAMILIES

Income of the 517 white families during the year preceding the interview averaged $4,827; that of the 291 Negro families, $1747. In this study income was defined as the sum of receipts from farm operation minus farm expenses; wages and salaries; non-farm business receipts minus business expenses; and all other non-farm income except non-recurrent income such as inheritances. Forty-six percent of the white families and 92 percent of the Negro families had per capita incomes of less than $1200 a year.

Estimating the size of the family by taking the total number of meals served from the home supply during the report week and dividing by 21 (the number of meals in one week), we found an average size for white families of 3.41 persons; for Negro families, 3.88 persons. Food costs per person per meal were less than 20 cents in 26 percent of the white families and in 67 percent of the Negro families.

Thirty-two percent of the white and 41 percent of the Negro homemakers had been away from home during the week preceding the interview due to full or part-time gainful work. Sixty-five percent of the white homemakers had been reared in the rural South, 31 percent in the urban South, and 4 percent outside the South. Eighty percent of the Negro women had been reared in the rural South and 20 percent in the urban South.

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[1] This is an analysis of some of the Mississippi data obtained in connection with the Southern Regional Marketing Study SM-13 Revised.

Eighty-five percent of the white homemakers and 33 percent of the Negro homemakers had had 9th grade schooling or more. Range of age of white and Negro homemakers was approximately the same. About one-half of the white and Negro women were under 40 years of age; about one-half 40 years and over.

## BEVERAGES BY FAMILY MEMBERS

### Milk at Meals

In Table I is shown the percentage of members in white families who usually drink milk in some form (whole, skim, buttermilk, or chocolate milk) at each of the meals and in warm and cold weather. Three facts stand out in this table: (1) Larger percentages of males than females have milk as their usual drink; (2) Larger percentages of younger children than teen-agers, and of teen-agers than male heads of households and homemakers, have milk as their usual drink at meals; (3) Milk is used somewhat more often as the usual drink in cold than in warm weather. The second and third facts are also true of Negro families (See Table II).

Appendix Tables 1-12 show usual beverages at each meal and between meals by race and season.

For breakfast the chief competitor of milk was coffee for male

Table I. Members of 517 white urban families who usually drink milk at meals in warm and cold weather.

| Family members | BREAKFAST | | NOON MEAL | | EVENING MEAL | | Total persons |
|---|---|---|---|---|---|---|---|
| | Warm weather | Cold weather | Warm weather | Cold weather | Warm weather | Cold weather | |
| | Percent | | Percent | | Percent | | No. |
| Male heads | 8 | 7 | 20 | 29 | 42 | 50 | 468 |
| Homemakers | 5 | 4 | 13 | 26 | 35 | 41 | 516 |
| Teen-age boys | 58 | 52 | 67 | 86 | 62 | 80 | 86 |
| Teen-age girls | 35 | 44 | 50 | 70 | 53 | 75 | 92 |
| Boys (12 & under) | 74 | 77 | 70 | 88 | 78 | 88 | 261 |
| Girls (12 & under) | 70 | 73 | 67 | 88 | 72 | 86 | 244 |

Table II. Members in 291 Negro urban families who usually drink milk at meals in warm and cold weather.

| Family members | BREAKFAST | | NOON MEAL | | EVENING MEAL | | Total persons |
|---|---|---|---|---|---|---|---|
| | Warm weather | Cold weather | Warm weather | Cold weather | Warm weather | Cold weather | |
| | Percent | | Percent | | Percent | | No. |
| Male heads | 13 | 10 | 19 | 28 | 32 | 37 | 233 |
| Homemakers | 15 | 10 | 16 | 25 | 25 | 30 | 291 |
| Teen-age boys | 48 | 44 | 41 | 46 | 40 | 52 | 73 |
| Teen-age girls | 52 | 52 | 59 | 67 | 41 | 48 | 56 |
| Boys (12 & under) | 77 | 76 | 62 | 73 | 52 | 67 | 238 |
| Girls (12 & under) | 74 | 77 | 58 | 69 | 59 | 70 | 240 |

heads of households, homemakers, and teen-agers in white families. However, in warm weather juices were as important as coffee for the teen-age girls. For white children 12 years and under juices played a more important role than coffee except to the young boy (12 years and under) in cold weather.

For the noon and evening meals coffee and iced tea were strong competitors of milk. Tea was especially important in warm weather though it was the usual drink of a number in cold weather as well, especially of children who less often drank coffee.

Coffee was the beverage which was the main competitor of milk for breakfast in all Negro family groups, except those of young children (12 years and under). Here juices (including powdered drinks) were the main competitors of milk. Coffee and iced tea were the main competitors of milk for Negro adults at the noon and evening meals. For Negro teen-agers soft drinks were also important competitors at these meals. For younger children (12 years and under) juices including powdered drinks were also an important competitor of milk at the noon and evening meals (See Tables 1 - 12 in Appendix).

The percentage of members having milk as their usual drink was higher in white groups than in Negro groups except for the breakfast meal (Tables I and II). Since more Negro than white male heads of households and homemakers report no usual drink at meals, the percentage of Negroes having milk as the usual drink might be lower than whites (Tables 1 and 2); even though milk was the beverage most often named as the usual one (Table 3) by the Negro family. This is, for example, what happened in the case of usual drink for male heads of households and homemakers at the noon meal in cold weather (Table III).

Milk was most often named as the usual beverage for teen-agers and children 12 years and under at each of the three meals in warm and cold weather. However, other beverages were named at breakfast in both warm and cold weather for white and Negro male heads of households and homemakers, (Table III) at the noon meal in both warm and cold weather for white male heads of households and homemakers, and in warm weather at the noon meal for Negro male heads of households and homemakers.

### Milk Between Meals

Tables IV and V show the percentage of members in white and Negro families who usually drink milk or milk drinks between meals in cold and warm weather. The habit of drinking milk between meals is somewhat more common among members of white than Negro families. Drinking milk between meals is more common among younger than older members. Milk was more usually drunk in mid-morning and afternoon by young children and in the evening before retiring by male heads of households and homemakers.

Coffee was the main competitor of milk as a between-meal beverage of white adults; soft drinks of Negro adults and of both white and Negro teen-agers (see Tables 1 - 12 in Appendix). Soft drinks were also the main competitors of milk at snack time in the afternoons and evenings for both white and Negro children 12 years and under. However, juices and powdered drinks were more important than soft drinks as a morning snack for these young children.

### Factors Related to Beverage Use

Relationships were studied of the homemakers' usual beverage at the evening meal in warm and cold weather to the male heads of households' usual beverage at the evening meal in warm and cold weather. Highly significant relationships were found in the beverage used at this meal by both white and Negro male heads of households and homemakers in both warm and cold weather. Also, significant relationships[2] were found in beverages used at this meal by both white and Negro male heads of households in the two seasons as well as in beverages used at this meal by both white and Negro homemakers in the two seasons.

A study was made of the relationship in income per capita and type of usual beverage at meals and snacks in warm and cold weather by members in white and Negro families. Beverages used by family members at and between meals in warm and cold weather were classified as follows: (1) Cof-

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[2] Significant at the 1% level.

Table III. Beverage most often named as usual one for specified persons, mals and seasons.

| Family members | BREAKFAST |  | NOON MEAL |  | EVENING MEAL |  |
|---|---|---|---|---|---|---|
|  | Warm weather | Cold weather | Warm weather | Cold weather | Warm weather | Cold weather |
| WHITE FAMILIES |  |  |  |  |  |  |
| Male heads | Coffee | Coffee | Iced tea | Coffee | Milk | Milk |
| Homemakers | Coffee | Coffee | Iced tea | Coffee | Iced tea | Milk |
| Teen-age boys | Milk | Milk | Milk | Milk | Milk | Milk |
| Teen-age girls | Milk | Milk | Milk | Milk | Milk | Milk |
| Boys 12 & under | Milk | Milk | Milk | Milk | Milk | Milk |
| Girls 12 & under | Milk | Milk | Milk | Milk | Milk | Milk |
| NEGRO FAMILIES |  |  |  |  |  |  |
| Male heads | Coffee | Coffee | Iced tea | Milk | Milk | Milk |
| Homemakers | Coffee | Coffee | Iced tea | Milk | Milk | Milk |
| Teen-age boys | Milk | Milk | Milk | Milk | Milk | Milk |
| Teen-age girls | Milk | Milk | Milk | Milk | Milk | Milk |
| Boys 12 & under | Milk | Milk | Milk | Milk | Milk | Milk |
| Girls 12 & under | Milk | Milk | Milk | Milk | Milk | Milk |

Table IV. Members in 517 white urban families who usually drink milk between meals in warm and cold weather.

| Family members | MORNING SNACK |  | AFT'NOON SNACK |  | EVENING SNACK |  | Total persons |
|---|---|---|---|---|---|---|---|
|  | Warm weather | Cold weather | Warm weather | Cold weather | Warm weather | Cold weather |  |
|  | Percent |  | Percent |  | Percent |  | No. |
| Male heads | 6 | 7 | 7 | 7 | 16 | 7 | 468 |
| Homemakers | 3 | 3 | 4 | 3 | 7 | 8 | 516 |
| Teen-age boys | 10 | 11 | 16 | 22 | 23 | 27 | 86 |
| Teen-age girls | 7 | 8 | 11 | 12 | 15 | 23 | 92 |
| Boys 12 & under | 36 | 42 | 33 | 39 | 27 | 28 | 261 |
| Girls 12 & under | 34 | 39 | 34 | 41 | 26 | 26 | 244 |

**Table V. Members in 291 Negro urban families who usually drink milk between meals in warm and cold weather.**

| Family members | MORNING SNACK | | AFT'NOON SNACK | | EVENING SNACK | | Total persons |
|---|---|---|---|---|---|---|---|
| | Warm weather | Cold weather | Warm weather | Cold weather | Warm weather | Cold weather | |
| | Percent | | Percent | | Percent | | No. |
| Male heads | 3 | 3 | 2 | 4 | 4 | 4 | 233 |
| Homemakers | 2 | 4 | 1 | 3 | 8 | 4 | 291 |
| Teen-age boys | 12 | 10 | 10 | 8 | 1 | 1 | 73 |
| Teen-age girls | 9 | 9 | 5 | 4 | 2 | 2 | 56 |
| Boys 12 & under | 23 | 26 | 21 | 22 | 18 | 18 | 238 |
| Girls 12 & under | 26 | 27 | 25 | 26 | 15 | 16 | 240 |

fee, tea, and soft drinks (mostly caffein drinks); (2) Milk and milk drinks; (3) Other, (mostly fruit or vegetable juices or powdered drinks); (4) None or don't know.

More significant differences[3] in usual beverage of male heads of households and homemakers and income per capita were found (1) in snacks than in meals; (2) in Negro than in white people; (3) in cold than in warm weather; (4) in male heads of households than in homemakers; and (5) in evening snacks than at other times.

More significant differences[3] in usual beverage of children of teen-age and of 12 years and under and income per capita were found (1) in snacks than in meals; (2) in Negro than in white children; (3) in cold than in warm weather; (4) in male teen-agers and younger male children than in female teen-agers and younger female children; and (5) in evening snacks than at other times.

At lower income levels more members reported no usual drink. At higher income levels more reported milk or milk drinks, coffee, tea, soft drinks, and/or other drinks.

Other factors studied possibly related to usual beverage by male heads of households and homemakers included schooling of male heads of households and homemakers, age of male heads of households and homemakers; home background of male heads of households and homemakers, and employment away from home.

More significant differences [4] in usual beverage of male heads of households and homemakers and schooling were found (1) in warm than in cold weather; (2) in white than in Negro adults. At lower educational levels more reported no beverage and at higher educational levels more reported milk, other drinks, or caffein drinks.

More significant differences [4] in usual beverage of male heads of households and homemakers and age were found (1) in white than in Negro adults; (2) in cold than in warm weather; (3) in evening meals than at other meals or snacks. Younger adults more often reported usual beverage of a caffein drink and older adults of milk, no drink, or "other" drink.

Most of the significant differences[4] in usual beverage of male heads of households and homemakers and rural Southern and urban Southern background centered in the evening snack. More adults with a rural Southern than an urban Southern background had milk at this snack time. Those having an urban Southern background more often had as the usual drink coffee or "other" drinks.

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[3] Significant at the 5% or 1% level. See Tables 13 and 14 in Appendix.

No significant differences[4] in usual beverage of Negro homemakers and employment away from home were found. However, significant differences were found in usual beverage of employed and unemployed white homemakers at morning and afternoon snacks. Employed women more often had caffein drinks as their usual beverage at the mid-morning and mid-afternoon snack. Unemployed women more often had milk, "other" drinks, or no drinks.

## HOMEMAKER'S BEVERAGE FOR A QUICK PICK-UP

Every homemaker was asked: What do you drink, if anything, for a quick pick-up or extra pep? Seventy-eight percent of the white homemakers and 68 percent of the Negro homemakers reported a drink they use for a quick pick-up. These drinks were:

| | White homemakers Percent | Negro homemakers Percent |
|---|---|---|
| Soft drinks | 45 | 70 |
| Coffee | 34 | 18 |
| Fruit or vegetable juice or powdered drink | 7 | 7 |
| Milk and milk drinks | 8 | 5 |
| Tea | 6 | 0 |

A significant relationship was found in replies to this question by white homemakers and their age; also, in their replies and their schooling.[5] More young homemakers replied coffee; more older homemakers, soft drinks and milk. More homemakers with 8th grade or less schooling replied soft drinks; more with college training, coffee.

Cola drinks (the most commonly used soft drinks) as well as coffee contain caffein. Soft drinks and coffee with sugar added also contain sugar which furnishes energy. However, milk and milk drinks furnish milk-sugar as well as protein, and this gives a longer lasting pick-up.

## HOMEMAKER'S BEVERAGE AT BEDTIME

When asked, "Do you ever have something to drink just before going to bed?", thirty percent of the white homemakers and 21 percent of the Negro homemakers replied, "Yes". Thirteen percent of the white women and 6 percent of the Negro women named milk or a milk drink. About 8 percent of the white women and 6 percent of the Negro women had reported milk as the usual drink at the evening snack.

A significant relationship[6] was found in replies of white homemakers to this question and their home background. Those who had a Southern rural background more often replied milk and soft drinks; those with a Southern urban background, coffee.

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[4] Significant at the 5% or 1% level. See Table 13 in Appendix.

[5] Significant at the 5% level.

[6] Significant at the 1% level.

## HOMEMAKER'S OPINION OF GUEST ASKING FOR MILK

The homemaker was asked: Suppose you are having a party or a social meeting of some grown people at your home in the evening. You ask the guests what they would like to drink. One asks for a glass of milk. What do you think of someone asking for milk?

Most homemakers thought it was all right for an adult guest to suggest milk. Opinions might be briefly summarized as follows:

| Opinions | White homemakers* Percent | Negro homemakers* Percent |
|---|---|---|
| O.K., if he likes or prefers | 59 | 65 |
| Asks for diet or health reasons | 27 | 16 |
| Strange; unusual; odd; rude | 11 | 12 |
| Other | 1 | 2 |

*Does not add up to 100% since some did not express an opinion.

Only about one in ten women disapproved of suggesting milk, as indicated by replies such as "strange", "unusual", "odd", "rude". This means that these women were more favorable to the idea of other adults drinking milk in the evening than followed the practice.

A significant relationship[7] was found in replies of white homemakers to this question and the family per capita income. Those with per capita incomes under $600 more often mentioned health and diet reasons; those with per capita incomes of $2400 and over more often replied, "O.K.", "they prefer milk", "they want milk".

## DESSERTS USED BY THE FAMILY

### Desserts Families Use Most Frequently

Each of the 808 homemakers were asked: Which of these would you say your family uses most frequently for **desserts** and for **snacks.** Each homemaker was handed a list of desserts printed on a card — ice cream; ice milk or dairy cream; pies; cakes; cookies; fruits.

Desserts mentioned first by white and Negro homemakers as used most frequently were:

| Desserts | White homemakers Percent | Negro homemakers Percent |
|---|---|---|
| Ice cream | 38 | 37 |
| Pies | 32 | 26 |
| Cakes | 15 | 21 |
| Fruits | 8 | 8 |
| Cookies | 6 | 7 |
| No choice, no information | 1 | 1 |

Ice cream was the dessert used most frequently in both white and Negro families. It was second in importance in 18 percent of the white and 11 percent of the Negro families, and third in importance in 9 percent of the white and in 7 percent of the Negro families. Ice cream's greatest competitor as a dessert was pie, and its next greatest was cake.

### Desserts Most Frequently Used as Snacks

Desserts used as snacks were quite different from those used as desserts. First mentioned by white and Negro homemakers as used for snacks were:

| Dessert as snack | White homemakers Percent | Negro homemakers Percent |
|---|---|---|
| Cookies | 46 | 43 |
| Fruits | 20 | 20 |

| | | |
|---|---|---|
| Ice cream | 12 | 12 |
| Cakes | 6 | 6 |
| Pies | 2 | 3 |
| None; no choice made | 14 | 16 |

Ice cream was second in importance as a snack in 10 percent of the white and in 7 percent of the Negro families, and was third in importance in 6 percent of the white and 5 percent of the Negro families.

The greatest competitors of ice cream as a snack were cookies and fruit. Both were used more frequently than ice cream.

### Desserts Families Like Best

Every homemaker was asked about the two desserts her family liked best. First mentioned by white and Negro homemakers were:

| Dessert liked best | White homemakers* Percent | Negro homemakers* Percent |
|---|---|---|
| Pies, cobblers, or short cakes | 44 | 32 |
| Cakes or cookies | 14 | 25 |
| Ice cream | 20 | 12 |
| Other milk desserts | 11 | 12 |
| Fruit or fruit desserts | 2 | 8 |
| Gelatin desserts | 3 | 6 |
| Ice cream with other desserts | 2 | 1 |
| Sherberts, ices | 1 | 2 |

*Does not add to 100% since some said they didn't like sweets or gave no information.

Fourteen percent of the white and 9 percent of the Negro women gave ice cream second place as the most liked dessert by the family. To be noted is the fact that white and Negro families used ice cream most often as a dessert but liked pies, cobblers, and short cakes best.

### Factors Related To Dessert Use and Preference

Factors related to the dessert served most frequently as a dessert and as a snack and to the dessert liked best were studied. More significant relationships were found between frequency of serving desserts and these factors than between dessert liked best and these factors (see Table 15 in Appendix).

White families in Meridian and Clarksdale more often mentioned ice cream as the dessert served most frequently than did white families in the smaller cities, Winona and Picayune. This was not the case with Negro families in larger and smaller cities. Younger homemakers, both white and Negro, more often mentioned pies and cakes as a dessert served most frequently than did older homemakers. Size of household was a significant factor in the choice of desserts by white homemakers, food cost per person per meal by Negro homemakers. Those Negro families spending most per person per meal more often reported ice cream as the dessert served most frequently.

Only one relationship was found in the second dessert named as served most frequently and factors examined. This was for white families and age of homemaker (see Table 15 in Appendix). Here, too, there was found a tendency for younger homemakers to more often name cakes, pies, and cookies than older homemakers.

Also, desserts used most frequently as snacks and age of white and Negro homemakers were related. More younger homemakers than older named cookies as first choice of the snack. Other relationships found in first choice of dessert served more frequently were by white families, income per capita, food cost per person per meal, and size of household; by Negro families, occupation of male heads of households. More white families of higher than lower income named fruit as a snack; more of the white families with higher than lower food expense per person per meal named ice cream as a snack; more larger than smaller white families named cookies as a snack; more Negro families with heads of households in occupations other than the unskilled or semiskilled type named ice cream as a snack. To be noted is the fact that significant relationships in most frequent dessert used as a snack mentioned second and age of homemaker, food cost per person per meal and size of household were also found (see Table 15 in Appendix).

Few significant relationships were found in replies to the question about dessert family likes best and factors examined. This question is of course less factual than is the one dealing with dessert served most frequently. As will be noted in Table 15 in the Appendix, a significant relationship was found in both education and age of homemaker and dessert family likes best. Older homemakers reported family likes best ice cream more than did younger homemakers. Women with college training more often named pies, cobblers, cakes, than did those with eighth grade or less schooling. Many items that might show a relationship, such as age and schooling, are often highly interrelated. This cause-effect relationship can be recognized but not separated.

In only one factor examined was there a significant relationship in the reply given by Negro families as to the best liked dessert and one of the factors. This was in the dessert named second and household size. (See Table 15 in Appendix).

## HOMEMAKER'S AND FAMILY'S FAVORITE FLAVOR ICE CREAM

Favorite flavors of ice cream of homemakers and families were the same. Preferred by the largest percentage were first vanilla, then chocolate, and third, strawberry. However, Negro homemakers and their families preferred strawberry about the same as chocolate. The percentage preferring these three flavors was as follows:

| Flavor ice cream preferred by homemaker | White families | Negro families |
|---|---|---|
| | Percent | |
| Vanilla | 59 | 67 |
| Chocolate | 13 | 8 |
| Strawberry | 10 | 9 |
| Flavor ice cream preferred by family | | |
| Vanilla | 55 | 56 |
| Chocolate | 14 | 9 |
| Strawberry | 8 | 8 |

A highly significant[8] relationship was found in homemaker's and family's favorite flavor of ice cream. A significant relationship was found in favorite flavor of ice cream and home background of Negro homemaker. More women reared in the rural South than in the urban South preferred vanilla ice cream.

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[7] Significant at the 5% level.

[8] Significant at the 1% level.

## HOMEMAKER'S FIRST THOUGHT ON USE OF ICE CREAM FOR GUEST MEAL

Homemakers were told to imagine they were at a company dinner at a friend's house. You have a very nice dinner. She serves ice cream for dessert. What would be your first thought?

White and Negro homemakers expressed the following "first thoughts".

| First thoughts | White homemakers Percent | Negro homemakers Percent |
|---|---|---|
| Definite approval | 45 | 68 |
| Indifferent approval (such as, O.K. if she wants it) | 14 | 12 |
| Disapproval | 12 | 5 |
| Incomplete dessert | 5 | 7 |
| Easy, quick, convenient | 7 | 2 |
| Fattening, don't want | 5 | 3 |
| Too heavy with meal | 6 | 2 |
| Easiest way out | 4 | 1 |
| Other | 1 | * |
| Don't know; or no reply | 1 | * |

*Less than. 5 percent.

As will be noted, most homemakers approved of the ice cream dessert; but there were some women who disagreed in a general way, others more specifically. A few thought ice cream an incomplete dessert. Others, that it was too heavy a dessert; still others, that the hostess was taking the easy way out.

## DESSERT HOMEMAKER WOULD SERVE TO GUESTS AND REASON

After the homemaker had been asked to tell her first thought at being served ice cream at a dinner meal at a friend's home, she was then asked what she would serve as dessert and why. Homemakers replied as follows:

| Dessert would serve guests | White homemakers* Percent | Negro homemakers* Percent |
|---|---|---|
| Pies, cobblers, or short cakes | 32 | 22 |
| Ice cream | 19 | 28 |
| Ice cream with another dessert | 16 | 19 |
| Cakes or cookies | 11 | 10 |
| Gelatin desserts | 4 | 8 |
| Sherberts, ices | 6 | 5 |
| Fruit or fruit desserts | 4 | 4 |
| Milk desserts | 4 | 3 |

*Does not add up to 100 percent as some gave no information.

More white women would serve pies, cobblers, or short cakes; more Negro women, ice cream. Reasons given varied with type of dessert. For example, for pies, cobblers, short cakes, cakes, cookies, and milk desserts reasons given were most often "like it", "homemade". For fruit or gelatin desserts and sherbets reasons were most frequently "a light dessert", "easy and quick". For ice cream reasons were most often, "like it", "easy or already prepared".

There was a highly significant relationship in what dessert the homemaker would serve to guests and the reason given. This was the case with white as well as with Negro homemakers.

## SUMMARY AND IMPLICATIONS

It was the purpose of this report to present findings concerning use of milk, ice cream, and competing beverages and desserts.

Data from 517 white and 291 Negro urban families in Meridian, Clarksdale, Picayune, and Winona, Mississippi, are included.

Income of the 517 white families during the year preceding the interview averaged $4827; that of the Negro families, $1747. White families averaged 3.41 persons; Negro families, 3.88 persons. Eighty-five percent of the white homemakers and 33 percent of the Negro homemakers had had ninth grade schooling or more.

At meals in white families (1) a larger percentage of males than females have milk as their usual drink; (2) a larger percentage of young children than teen-agers, and teen-agers than male heads of households and homemakers, have milk as the usual drink; (3) milk is used somewhat more often as the usual drink in cold than in warm weather. The second and third facts are also true in Negro families.

The percentage of white family members having milk as their usual drink was higher than the percentage of Negro family members having it, except for the breakfast meal.

The chief competitors of milk at meals were coffee, iced tea, fruit and vegetable juices (including powdered drinks), and soft drinks.

The habit of drinking milk between meals is more common among members of white than Negro families. It is more common among children than adults. The same drinks that were competitors of milk at meals were also competitors at between-meal snacks.

At lower income levels more members reported no usual drink at or between meals. At higher income levels more reported milk or milk drinks, coffee, tea, soft drinks, and/or other drinks.

A significant relationship was found between the beverage used for a "quick pick-up" and the age of the homemaker. More younger homemakers used coffee; more older homemakers used soft drinks or milk for their pick-up.

Thirty percent of the white and 21 percent of the Negro homemakers reported a beverage at bedtime. A significant relationship was found in replies of white homemakers to this question and their home background. Women who had a Southern rural background more often reported milk and soft drinks as the evening snack; those with a Southern urban background reported coffee.

Only about one in ten homemakers interviewed gave opinions indicating disapproval of an adult guest suggesting milk for her drink at a social meeting in the evening.

Ice cream was the dessert used most frequently in both white and Negro families. Pies and cakes were its biggest competitors. However, cookies and fruits were both used as snacks more often than was ice cream.

Younger homemakers more often mentioned pies and cakes as the dessert served most frequently than did older homemakers. Those Negro families spending most per person per meal more often reported ice cream as the dessert served most frequently.

White homemakers ranked ice cream as second, Negro homemakers third, as the dessert liked best by their families.

Favorite flavors of ice cream of homemakers and their families were the same: vanilla, chocolate, and strawberry.

Most homemakers approved of being served ice cream as the dessert at a dinner party by their hostess. But there were some women who disagreed in a general way; others, more specifically.

Nineteen percent of the white homemakers and 28 percent of the Negro homemakers said they would serve ice cream to a guest at dinner. Sixteen percent of the whites and 19 percent of the Negroes would serve ice cream with another dessert such as cake or pie. Reasons for choice given varied with the dessert. For ice cream or ice cream with another dessert it was most often "like it", "easily or quickly prepared".

It would seem that this report had some important implications for home economists and the dairy industry in their education and milk promotion activities with families. Some implications for use of milk as a beverage are:

(1) In work with adults who drink little or no milk it would be well to begin with its use as a food for the evening meal or evening snack. This is the time when more milk is drunk by adults using it.

(2) It is important not to present milk as a nutritious drink to be used instead of specified non-milk drinks, since many family members use these drinks (coffee, iced tea, soft drinks) in preference to milk. The need for having milk at and between meals, even though one of the non-milk drinks is served, should be emphasized.

(3) The fact that milk is a food for adults as well as for children needs to be stressed continually.

(4) Since members like cold liquids, especially in warm weather, it would be well to stress in food preparation programs the desirability of last-minute serving of milk. Milk heats up soon when allowed to stand on the dining table. The practice of placing the cool drink on the table a little ahead of mealtime, so commonly folowed with non-milk drinks, can not be followed with milk since the milk is not iced and may sour if left out too long.

(5) More older women (women 50 years and over) than younger women prefer milk at certain mealtimes and seasons to some of the popular beverage stimulants. Good results, therefore, should be obtained in working with older women for increased use of milk.

(6) This study shows a great need for increased work with younger women in order to increase use of milk. Since many prefer non-milk drinks to milk, it would seem desirable to use with them the approach suggested in (2) above.

(7) It would seem that more milk consumption programs might well be directed to the low-income Negro family. A number of members in some of these families have no usual drink at the various meals.

(8) Programs should be directed especially to white women and girls who less often have milk than white men and boys.

Some implications for use of ice

cream as a dessert are:

(1) The two characteristics that seem to make ice cream a favorite dessert are: like it; it's easy, already prepared. These points need to be stressed continually in education and trade promotion. Also, it is important that the present reputation for "good taste" be maintained.

(2) More white families in larger than smaller cities mentioned ice cream as a dessert served most frequently. It may be that grocery stores and dairies in these smaller cities need assistance in modern promotion techniques.

(3) This study shows the need for increased work with younger women in uses of ice cream as a dessert.

(4) Since ice cream is the dessert liked best by more white than Negro families it might be well to center more attention on Negro groups in education and promotion programs.

(5) More older than younger women used ice cream frequently. Good results should be obtained on education and promotion of ice cream with oldsters.

(6) It would seem that ice cream might be promoted as an afternoon or evening snack.

(7) From analysis of these data it would seem that there should be developed more desserts of ice cream in combination with other desserts. In serving guests homemakers like to contribute something homemade to the menu. They like to serve a dessert which is distinctive and requires some thought or individuality in preparation. Vanilla ice cream seems an excellent media for such combination desserts.

## APPENDIX TABLES

**Table 1. Usual beverage of male heads of households in 517 white families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know* | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 77 | 1 | 0 | 8 | 2 | 12 | 468 |
| Cold weather | 78 | 2 | 0 | 7 | 2 | 11 | 468 |
| Noon meal | | | | | | | |
| Warm weather | 13 | 57 | 4 | 20 | 0 | 6 | 468 |
| Cold weather | 36 | 23 | 4 | 29 | 0 | 8 | 468 |
| Evening meal | | | | | | | |
| Warm weather | 15 | 34 | 2 | 42 | 1 | 6 | 468 |
| Cold weather | 32 | 11 | 1 | 50 | 0 | 6 | 468 |
| Morning snack | | | | | | | |
| Warm weather | 34 | 1 | 23 | 6 | 2 | 34 | 468 |
| Cold weather | 43 | 0 | 18 | 7 | 1 | 31 | 468 |
| Afternoon snack | | | | | | | |
| Warm weather | 33 | 1 | 28 | 7 | 1 | 30 | 468 |
| Cold weather | 41 | 1 | 18 | 7 | 1 | 32 | 468 |
| Evening snack | | | | | | | |
| Warm weather | 10 | 2 | 6 | 16 | 3 | 63 | 468 |
| Cold weather | 14 | 0 | 4 | 16 | 3 | 63 | 468 |

*A few "other" beverages such as beer have been listed here.

**Table 2.** **Usual beverage of male heads of households in 291 Negro families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know* | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 63 | 3 | 1 | 13 | 4 | 16 | 233 |
| Cold weather | 74 | 1 | 0 | 10 | 2 | 13 | 233 |
| Noon meal | | | | | | | |
| Warm weather | 10 | 22 | 21 | 19 | 11 | 17 | 233 |
| Cold weather | 20 | 10 | 15 | 28 | 6 | 21 | 233 |
| Evening meal | | | | | | | |
| Warm weather | 14 | 13 | 6 | 32 | 11 | 24 | 233 |
| Cold weather | 25 | 4 | 4 | 37 | 5 | 25 | 233 |
| Morning snack | | | | | | | |
| Warm weather | 7 | 0 | 24 | 3 | 2 | 64 | 233 |
| Cold weather | 11 | 0 | 16 | 3 | 1 | 69 | 233 |
| Afternoon snack | | | | | | | |
| Warm weather | 12 | 1 | 24 | 2 | 2 | 59 | 233 |
| Cold weather | 15 | 0 | 16 | 4 | 2 | 63 | 233 |
| Evening snack | | | | | | | |
| Warm weather | 2 | 0 | 9 | 4 | 1 | 84 | 233 |
| Cold weather | 4 | 1 | 7 | 4 | 0 | 84 | 233 |

*A few "other" beverages such as beer have been listed here.

**Table 3.** **Usual beverage of homemakers in 517 white families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know* | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 80 | 3 | 0 | 5 | 2 | 10 | 516 |
| Cold weather | 82 | 3 | 0 | 4 | 1 | 10 | 516 |
| Noon meal | | | | | | | |
| Warm weather | 9 | 68 | 4 | 13 | 0 | 6 | 516 |
| Cold weather | 34 | 27 | 3 | 26 | 0 | 10 | 516 |
| Evening meal | | | | | | | |
| Warm weather | 12 | 39 | 2 | 35 | 2 | 10 | 516 |
| Cold weather | 33 | 13 | 1 | 41 | 0 | 12 | 516 |
| Morning snack | | | | | | | |
| Warm weather | 29 | 2 | 27 | 3 | 4 | 35 | 516 |
| Cold weather | 40 | 1 | 11 | 3 | 3 | 42 | 516 |
| Afternoon snack | | | | | | | |
| Warm weather | 28 | 2 | 30 | 4 | 5 | 31 | 516 |
| Cold weather | 39 | 2 | 17 | 3 | 2 | 37 | 516 |
| Evening snack | | | | | | | |
| Warm weather | 12 | 1 | 6 | 7 | 2 | 72 | 516 |
| Cold weather | 16 | 0 | 3 | 8 | 2 | 71 | 516 |

*A few "other" beverages such as beer have been listed here.

**Table 4. Usual beverage of homemakers in 291 Negro families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know* | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 60 | 5 | 2 | 15 | 2 | 16 | 291 |
| Cold weather | 76 | 4 | 1 | 10 | 0 | 9 | 291 |
| Noon meal | | | | | | | |
| Warm weather | 5 | 32 | 11 | 16 | 16 | 20 | 291 |
| Cold weather | 20 | 12 | 8 | 25 | 8 | 27 | 291 |
| Evening meal | | | | | | | |
| Warm weather | 12 | 14 | 8 | 25 | 15 | 26 | 291 |
| Cold weather | 25 | 5 | 5 | 30 | 5 | 30 | 291 |
| Morning snack | | | | | | | |
| Warm weather | 9 | 1 | 21 | 2 | 4 | 63 | 291 |
| Cold weather | 11 | 1 | 14 | 4 | 2 | 68 | 291 |
| Afternoon snack | | | | | | | |
| Warm weather | 10 | 1 | 22 | 1 | 4 | 62 | 291 |
| Cold weather | 12 | 0 | 14 | 3 | 2 | 69 | 291 |
| Evening snack | | | | | | | |
| Warm weather | 2 | 4 | 7 | 18 | 2 | 67 | 291 |
| Cold weather | 3 | 1 | 6 | 4 | 1 | 85 | 291 |

*A few "other" beverages such as beer have been listed here.

**Table 5. Usual beverage of male teen-agers (13 - 19 years) in 517 white families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 24 | 1 | 0 | 58 | 6 | 11 | 86 |
| Cold weather | 28 | 5 | 0 | 52 | 3 | 12 | 86 |
| Noon meal | | | | | | | |
| Warm weather | 0 | 29 | 0 | 67 | 1 | 3 | 86 |
| Cold weather | 2 | 7 | 0 | 86 | 0 | 5 | 86 |
| Evening meal | | | | | | | |
| Warm weather | 1 | 28 | 1 | 62 | 3 | 5 | 86 |
| Cold weather | 5 | 5 | 3 | 80 | 2 | 5 | 86 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 28 | 10 | 2 | 60 | 86 |
| Cold weather | 0 | 0 | 23 | 11 | 0 | 66 | 86 |
| Afternoon snack | | | | | | | |
| Warm weather | 1 | 0 | 47 | 16 | 5 | 31 | 86 |
| Cold weather | 2 | 0 | 45 | 22 | 0 | 31 | 86 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 2 | 15 | 23 | 6 | 54 | 86 |
| Cold weather | 0 | 0 | 15 | 27 | 7 | 51 | 86 |

Table 6. Usual beverage of male teen-agers (13 - 19 years) in 291 Negro families at meals and snacks in warm and cold weather, 4 Mississippi cities.

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 21 | 0 | 7 | 48 | 8 | 16 | 73 |
| Cold weather | 23 | 0 | 4 | 44 | 4 | 25 | 73 |
| Noon meal | | | | | | | |
| Warm weather | 4 | 20 | 11 | 41 | 1 | 23 | 73 |
| Cold weather | 4 | 8 | 11 | 46 | 8 | 23 | 73 |
| Evening meal | | | | | | | |
| Warm weather | 4 | 5 | 18 | 40 | 10 | 23 | 73 |
| Cold weather | 4 | 0 | 8 | 52 | 4 | 32 | 73 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 10 | 12 | 3 | 75 | 73 |
| Cold weather | 0 | 0 | 10 | 10 | 3 | 77 | 73 |
| Afternoon snack | | | | | | | |
| Warm weather | 0 | 0 | 7 | 10 | 10 | 73 | 73 |
| Cold weather | 0 | 0 | 8 | 8 | 1 | 83 | 73 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 0 | 4 | 1 | 5 | 90 | 73 |
| Cold weather | 0 | 0 | 8 | 1 | 3 | 88 | 73 |

Table 7. Usual beverage of female teen-agers (13 - 19 years) in 517 white families at meals and snacks in warm and cold weather, 4 Mississippi cities.

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 24 | 2 | 2 | 35 | 26 | 11 | 92 |
| Cold weather | 27 | 2 | 1 | 44 | 16 | 10 | 92 |
| Noon meal | | | | | | | |
| Warm weather | 1 | 35 | 4 | 50 | 4 | 6 | 92 |
| Cold weather | 3 | 12 | 10 | 70 | 1 | 4 | 92 |
| Evening meal | | | | | | | |
| Warm weather | 3 | 34 | 1 | 53 | 3 | 6 | 92 |
| Cold weather | 6 | 10 | 2 | 75 | 1 | 6 | 92 |
| Morning snack | | | | | | | |
| Warm weather | 4 | 0 | 39 | 7 | 2 | 48 | 92 |
| Cold weather | 4 | 0 | 29 | 8 | 2 | 57 | 92 |
| Afternoon snack | | | | | | | |
| Warm weather | 4 | 0 | 50 | 11 | 6 | 29 | 92 |
| Cold weather | 5 | 2 | 45 | 12 | 3 | 33 | 92 |
| Evening snack | | | | | | | |
| Warm weather | 2 | 0 | 10 | 15 | 3 | 70 | 92 |
| Cold weather | 2 | 0 | 2 | 23 | 3 | 70 | 92 |

**Table 8. Usual beverage of female teen-agers (13 - 19 years) in 291 Negro families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 23 | 0 | 2 | 52 | 7 | 16 | 56 |
| Cold weather | 23 | 2 | 2 | 52 | 5 | 16 | 56 |
| Noon meal | | | | | | | |
| Warm weather | 4 | 5 | 12 | 59 | 9 | 11 | 56 |
| Cold weather | 5 | 7 | 5 | 67 | 5 | 11 | 56 |
| Evening meal | | | | | | | |
| Warm weather | 2 | 9 | 14 | 41 | 0 | 34 | 56 |
| Cold weather | 7 | 0 | 9 | 48 | 0 | 36 | 56 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 16 | 9 | 4 | 71 | 56 |
| Cold weather | 0 | 0 | 5 | 9 | 4 | 82 | 56 |
| Afternoon snack | | | | | | | |
| Warm weather | 0 | 0 | 29 | 5 | 2 | 64 | 56 |
| Cold weather | 0 | 0 | 27 | 4 | 2 | 67 | 56 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 0 | 11 | 2 | 0 | 87 | 56 |
| Cold weather | 0 | 0 | 5 | 2 | 0 | 93 | 56 |

**Table 9. Usual beverage of males (12 years and under) in 517 white families at meals and snacks in warm and cold weather, 4 Mississippi cities.**

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 6 | 0 | 0 | 74 | 9 | 11 | 261 |
| Cold weather | 7 | 0 | 0 | 77 | 5 | 11 | 261 |
| Noon meal | | | | | | | |
| Warm weather | 1 | 22 | 1 | 70 | 2 | 4 | 261 |
| Cold weather | 1 | 8 | 0 | 88 | 0 | 3 | 261 |
| Evening meal | | | | | | | |
| Warm weather | 1 | 14 | 2 | 78 | 2 | 3 | 261 |
| Cold weather | 1 | 5 | 1 | 88 | 0 | 5 | 261 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 12 | 36 | 16 | 36 | 261 |
| Cold weather | 0 | 0 | 9 | 42 | 7 | 42 | 261 |
| Afternoon snack | | | | | | | |
| Warm weather | 0 | 0 | 29 | 33 | 11 | 27 | 261 |
| Cold weather | 0 | 0 | 23 | 39 | 4 | 34 | 261 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 0 | 3 | 27 | 5 | 65 | 261 |
| Cold weather | 0 | 0 | 3 | 28 | 3 | 66 | 261 |

Table 10. Usual beverage of males (12 years and under) in 291 Negro families at meals and snacks in warm and cold weather, 4 Mississippi cities.

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 3 | 0 | 0 | 77 | 4 | 16 | 238 |
| Cold weather | 3 | 0 | 1 | 76 | 6 | 14 | 238 |
| Noon meal | | | | | | | |
| Warm weather | 0 | 5 | 4 | 62 | 18 | 11 | 238 |
| Cold weather | 0 | 4 | 3 | 73 | 7 | 13 | 238 |
| Evening meal | | | | | | | |
| Warm weather | 1 | 4 | 3 | 52 | 16 | 24 | 238 |
| Cold weather | 1 | 2 | 1 | 67 | 5 | 24 | 238 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 5 | 23 | 7 | 65 | 238 |
| Cold weather | 0 | 0 | 3 | 26 | 3 | 68 | 238 |
| Afternoon snack | | | | | | | |
| Warm weather | 0 | 0 | 11 | 21 | 7 | 61 | 238 |
| Cold weather | 0 | 0 | 8 | 22 | 2 | 68 | 238 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 0 | 2 | 18 | 0 | 80 | 238 |
| Cold weather | 0 | 0 | 2 | 18 | 0 | 80 | 238 |

Table 11. Usual beverage of females (12 years and under) in 517 white families at meals and snacks in warm and cold weather, 4 Mississippi cities.

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 6 | 0 | 0 | 70 | 13 | 11 | 244 |
| Cold weather | 6 | 0 | 0 | 73 | 12 | 9 | 244 |
| Noon meal | | | | | | | |
| Warm weather | 0 | 27 | 2 | 67 | 1 | 3 | 244 |
| Cold weather | 0 | 7 | 2 | 88 | 0 | 3 | 244 |
| Evening meal | | | | | | | |
| Warm weather | 0 | 20 | 4 | 72 | 1 | 3 | 244 |
| Cold weather | 0 | 8 | 2 | 86 | 0 | 4 | 244 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 12 | 34 | 22 | 32 | 244 |
| Cold weather | 0 | 0 | 6 | 39 | 10 | 45 | 244 |
| Afternoon snack | | | | | | | |
| Warm weather | 0 | 0 | 23 | 34 | 15 | 28 | 244 |
| Cold weather | 0 | 0 | 15 | 41 | 8 | 36 | 244 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 0 | 4 | 26 | 4 | 66 | 244 |
| Cold weather | 0 | 0 | 30 | 26 | 3 | 68 | 244 |

Table 12. Usual beverage of females (12 years and under) in 291 Negro families at meals and snacks in warm and cold weather, 4 Mississippi cities.

| Meal and season | Coffee | Tea | Soft drink | Milk | Juices & powdered drinks | None; Don't know | Total |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | No. |
| Breakfast | | | | | | | |
| Warm weather | 7 | 0 | 2 | 74 | 7 | 10 | 240 |
| Cold weather | 7 | 0 | 1 | 77 | 7 | 8 | 240 |
| Noon meal | | | | | | | |
| Warm weather | 0 | 6 | 3 | 58 | 21 | 12 | 240 |
| Cold weather | 1 | 4 | 2 | 69 | 9 | 15 | 240 |
| Evening meal | | | | | | | |
| Warm weather | 0 | 5 | 4 | 59 | 15 | 17 | 240 |
| Cold weather | 0 | 2 | 3 | 70 | 6 | 19 | 240 |
| Morning snack | | | | | | | |
| Warm weather | 0 | 0 | 5 | 26 | 8 | 61 | 240 |
| Cold weather | 0 | 0 | 5 | 27 | 5 | 63 | 240 |
| Afternoon snack | | | | | | | |
| Warm weather | 0 | 0 | 15 | 25 | 11 | 49 | 240 |
| Cold weather | 0 | 0 | 12 | 26 | 4 | 58 | 240 |
| Evening snack | | | | | | | |
| Warm weather | 0 | 0 | 2 | 15 | 1 | 82 | 240 |
| Cold weather | 0 | 0 | 2 | 16 | 0 | 82 | 240 |

Table 13. Relationship of usual beverage at meals and snacks of male heads of households and homemakers in white and Negro families to specified factors.[1]

| Person, meal and season | White families |  |  |  | Negro families |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  | Income per capita | Age | Schooling | Home background | Income per capita | Age | Schooling | Home background |
| MALE HEADS |  |  |  |  |  |  |  |  |
| Breakfast |  |  |  |  |  |  |  |  |
| Warm weather |  |  | XX |  |  | XX | X |  |
| Cold weather | X |  | XX |  |  |  |  |  |
| Noon meal |  |  |  |  |  |  |  |  |
| Warm weather |  |  |  |  |  |  |  |  |
| Cold weather |  |  |  |  | X |  |  |  |
| Evening meal |  |  |  |  |  |  |  |  |
| Warm weather |  | X |  |  |  |  |  |  |
| Cold weather | X | X | X |  |  | X |  |  |
| Morning snack |  |  |  |  |  |  |  |  |
| Warm weather |  | XX |  |  |  |  |  |  |
| Cold weather | X | XX |  |  |  |  |  |  |
| Afternoon snack |  |  |  |  |  |  |  |  |
| Warm weather |  |  |  |  | X |  |  |  |
| Cold weather |  | X |  |  | X |  |  |  |
| Evening snack |  |  |  |  |  |  |  |  |
| Warm weather | X |  | X | XX |  |  |  |  |
| Cold weather | X | XX | XX | X | XX |  |  |  |
| HOMEMAKERS |  |  |  |  |  |  |  |  |
| Breakfast |  |  |  |  |  |  |  |  |
| Warm weather |  |  |  |  |  |  |  |  |
| Cold weather |  |  |  |  |  |  |  |  |
| Noon meal |  |  |  |  |  |  |  |  |
| Warm weather |  |  |  |  | X |  | X |  |
| Cold weather |  |  |  |  | XX |  |  |  |
| Evening meal |  |  |  |  |  |  |  |  |
| Warm weather | X | XX |  |  |  | XX |  |  |
| Cold weather | X | XX |  |  |  | X |  |  |
| Morning snack |  |  |  |  |  |  |  |  |
| Warm weather |  | XX |  |  |  |  | X |  |
| Cold weather |  | XX |  |  | X |  |  |  |
| Afternoon snack |  |  |  |  |  |  |  |  |
| Warm weather |  | XX |  |  | XX |  |  | X |
| Cold weather |  | XX |  |  |  |  |  |  |
| Evening snack |  |  |  |  |  |  |  |  |
| Warm weather |  |  | XX | X | X |  | X |  |
| Cold weather |  | XX | XX | XX |  |  |  | XX |

X Significant at the 5% level according to chi-square tests.
XX Significant at the 1% level according to chi-square tests.

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[1] There was a highly significant relationship in employment of the white homemaker and her usual beverage in warm weather at the morning snack and a significant relationship in employment of the white homemaker and her usual beverage at the morning snack in cold weather and at the afternoon snack in both warm and coldweather. No significance was found in the employment of the Negro homemaker and her usual beverage at or between meals in warm or cold weather.

**Table 14.** Relationship of income per capita to usual beverage at meals and snacks of male and female children 13 - 19 years[1] and 12 years and under in white and Negro families.

| | White families | | | | Negro families | | |
|---|---|---|---|---|---|---|---|
| | Males | Females | Males | Females | Males | Males | Females |
| Meal and season | 13-19 | 13-19 | 12 and under | | 13-19 | 12 and under | |
| Breakfast | | | | | | | |
| Warm weather | | X | | | XX | | |
| Cold weather | | | | | XX | | XX |
| Noon meal | | | | | | | |
| Warm weather | | | | X | | | |
| Cold weather | | | XX | XX | XX | XX | |
| Evening meal | | | | | | | |
| Warm weather | | | XX | | | X | X |
| Cold weather | | | | | | | |
| Morning snack | | | | | | | |
| Warm weather | XX | | | | | XX | XX |
| Cold weather | X | | X | | | XX | XX |
| Afternoon snack | | | | | | | |
| Warm weather | | | | | | XX | XX |
| Cold weather | XX | | | | | X | XX |
| Evening snack | | | | | | | |
| Warm weather | X | | XX | X | | | XX |
| Cold weather | X | XX | X | X | | | X |

X Significant at the 5% level according to chi-square tests.

XX Significant at the 1% level according to chi-square tests.

[1] There was no significant relationship found in income per capita and the usual beverage at and between meals in warm and cold weather of Negro females 13-19 years of age.

Table 15. **Relationship of use and preferences of desserts in white and Negro families to specified factors.**

| Factors | White | Negro |
|---|---|---|
| 1. Dessert family serves most frequently (1st choice) | | |
| City size | XX | |
| Income per capita | | |
| Age of homemaker | XX | X |
| Occupation male head of household | | |
| Background of homemaker | | |
| Food cost per person per meal | | X |
| Size of household | XX | |
| Background male head of household | | |
| Employment of wife | | |
| 2. Dessert family serves most frequently (2nd choice) | | |
| Income per capita | | |
| Age of homemaker | X | |
| Occupation male head of household | | |
| Background of homemaker | | |
| Food cost per person per meal | | |
| Size of household | | |
| Background male head of household | | |
| Employment of wife | | |
| 3. Dessert family serves most frequently as a snack (1st choice) | | |
| Income per capita | XX | |
| Age of homemaker | XX | X |
| Occupation male head of household | | XX |
| Background of homemaker | | |
| Food cost per person per meal | X | |
| Size of household | XX | |
| Background male head of household | | |
| Employment of wife | | |
| 4. Dessert family serves most frequently as a snack (2nd choice) | | |
| Income per capita | | |
| Age of homemaker | XX | |
| Occupation male head of household | | |
| Background of homemaker | | |
| Food cost per person per meal | X | |
| Size of household | X | |
| Background male head of household | | |
| Employment of wife | | |
| 5. Dessert family likes best (1st choice) | | |
| Income per capita | | |
| Age of homemaker | X | |
| Education of homemaker | XX | |
| Food cost per person per meal | | |
| Size of household | | |
| Background of homemaker | | |
| Background male head of household | | |
| What homemaker is doing about weight | | |
| 6. Dessert family likes best (2nd choice) | | |
| Income per capita | | |
| Age of homemaker | | |
| Education of homemaker | | |
| Food cost per person per meal | | |
| Size of household | | X |
| Background of homemaker | | |
| Background male head of household | | |
| What homemaker is doing about weight | | |

X Significant at the 5% level according to chi-square tests.
XX Significant at the 1% level according to chi-square tests.

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## Let's Look at

# Hospital-Community Relations

## A Report to the Hospital Service Industry

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## CHARACTERISTICS OF HOSPITALS ASSOCIATED WITH THE QUALITY OF THEIR PUBLIC RELATIONS PROGRAMS

(1) **Age of Hospital**—Hospitals which were judged to have generally "good" relations with their publics were considereably newer than hospitals which did not have "good" public relations.

(2) **Type of Ownership**—A much higher percentage of the hospitals with "good" public relations than those with "poor" public relations were publicly owned Hill-Burton units.

(3) **Percentage of Bills Paid by State and Charitable Organizations**—Hospitals with "poor" public relations rendered very little charity care compared to a high percentage of charity care rendered by those with "good" public relations.

(4) **Method of Founding**—Hospitals with "good" public relations were founded by community leaders at large and involved a prior commitment of financial support (through the bond issue) before construction. Hospitals which were founded by medical doctors generally had "poor" public relations.

(5) **Size of Hospital and of Hospital Community**—Although size of the hospital and of the hospital community were not significantly related to the quality of the hospital's public relations, there was a tendency for hospitals with "good" public relations to be above average in size and located in larger communities. This also means that these hospitals were better equipped; the average length of stay in them was longer; and in most cases they had a staff which could handle a wide variety of cases and procedures.

## CHARACTERISTICS OF HOSPITAL ADMINISTRATORS ASSOCIATED WITH THE QUALITY OF THEIR PUBLIC RELATIONS

(1) **Type of Job Training**—Almost all of the administrators with "good" public relations had had training in hospital administration. Only one administrator whose public relations were "poor" had had such training.

(2) **Professional Identification**—Administrators whose public relations were "good" generally identified with only one profession (hospital administration). About one-half of the administrators whose public relations were "poor" were medical doctors and identified professionally with medicine as well as administration.

(3) **Salary**—Administrators whose public relation were "good" received higher salaries than those whose public relations were "poor". The median salary of the first group of administrators was $8,500; for the second group it was $5,000.

(4) **Job Mobility**—Administrators whose relations were "good" have changed hospital jobs less frequently than those whose public relations were "poor". If both hospital and non-hospital jobs are considered, however, administrators whose public relations were "good" have changed jobs more frequently.

(5) **Participation in Professional Organizations**—Administrators whose public relations were "good" were much more active in professional organizations than were administrators whose public relations were "poor" as measured by number of organizational memberships and number of offices held.

(6) **Participation in Community Affairs**—Administrators whose public relations were "good" participated in an average of three comunity organizations and held two offices in these organizations. Administrators whose public relations were "poor" belonged to an average of two community organizations and held one office.

# LET'S LOOK AT HOSPITAL COMMUNITY RELATIONS: A REPORT TO THE HOSPITAL SERVICE INDUSTRY

GERALD O. WINDHAM and MARION T. LOFTIN

During the past several years members of the Division of Sociology and Rural Life at Mississippi State University have been engaged in a study of the relationships between hospitals and their several publics. The purposes of the study were: (1) to determine the acceptance of hospitals by their various publics in the community, and (2) to arrive at criteria or standards that could be used by hospital administrators and other hospital personnel for establishing a program of favorable public relations between the hospital, its several publics, and the community at large.

The assumption upon which the study was based was that the hospital as a local institution has a number of different kinds of publics with which it must maintain favorable relationships if it is to render maximum service to the community. Some of the groups which were assumed to be publics of the hospital were: (1) the board of trustees and other governing bodies, (2) persons employed by the hospital, (3) the medical staff, (4) former and potential patients of the hospital, (5) the local community leaders, (6) persons and agencies interested in community welfare, and (7) the people and groups instrumental in establishing and developing the hospital.

The relationships between each of these publics and the local hospital have been studied in a number of ways: (1) data were obtained from the Mississippi Hospital Association on hospitals and hospital administrators in the state; (2) personal interviews and mailed questionnaires were used to elicit information from hospital administrators on themselves and their hospitals; and (3) field studies were conducted in three hospital communities to gather information on the status of the hospital in the community and to observe factors which were related to the status of the hospital. In addition, the quality of the public relations of each short term general hospital and of its administrator was rated by a panel of judges whose daily work required them to maintain close contact with the hospitals. On the basis of this ranking the quality of the public relations of hospitals and of their administrators were grouped as "good" or "poor", and the analysis of data made. Significant differences between hospitals and hospital administrators with "good" or "poor" public relations were shown at the beginning of this report.

## The Administrator Holds the Key

There is considerable evidence that the success of the hospital which is not a part of a regional or state medical center is largely dependent upon the hospital administrator. This person not only must know the facts and figures associated with hospital management, but he must be able to discern the "human factors" which are involved in the operation of his hospital and be able to manipulate them to his hospital's advantage.

In discerning the "human factors", the administrator must know his publics and be able to work harmoniously with each. It should be remembered that the success of the hospital depends ultimately on the support of the general public. This group not only is the consumer of the services, but it is also this group which must provide financial support and a

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place in the community for the new county hospitals. The relationships of the administrator with each of the hospital's publics will eventually influence the relationships with the general public. This is true because membership in each of the publics overlaps. Also the promotion and selling of the hospital among the general public can perhaps be better accomplished by members of the various publics than by the hospital itself.

It is impossible to write a formula which will guide the administrator in all of his relationships with each of the hospital's publics. This is true because the way to effective public relations varies according to the unique situation of each hospital. This situation includes factors which are a part of the hospital itself as well as community and "human" factors which constitute the environment in which it must operate. It is hoped that the following materials will help the administrator to know his publics and will give some insight into the importance of the "human factors". Then he can discern the unique situation of his hospital, and can set realistic public relations goals as well as means to accomplish the goals.

### The General Public

Inasmuch as the larger general public is the ultimate group with whom acceptance of the hospital lies the first concern in evaluating the effectiveness of public relations programs will be with this group. There are several criteria which administrators may use to judge this. One is use of hospital. Many administrators who have no apparent competition tend to assume that their hospital has a monopoly in the community. This study has shown this not to be the case. Persons who do not like a hospital will drive a long distance to use one they do like. There may be several reasons why persons do not like a hospital. Some may be inherent in the hospital itself — such as size of the hospital, distrust of the hospital and its medical staff, lack of equipment and personnel to handle certain types of cases adequately, and poor treatment of patients and their family by the nursing staff and the business office. Other reasons may be external to the hospital, such as traditional use of physicians and hospitals in other communities, dislike for the hospital and/or its administrator for various reasons, failure of the hospital to render charity care, or strained relationships between the hospital and large segments of the population. The effective administrator should be able to recognize groups who do not use his hospital, to determine why, and to formulate means whereby these conditions may be corrected.

A second index of effectiveness with the general public is the opinion which persons in the hospital's area have of the hospital. The administrator should make some effort to determine the likes and dislikes of persons toward the hospital, and to determine what factors are responsible for these opinions. This type of information is not always easy to acquire; however, it may be acquired through a little time and effort. Patients and their families can be asked to leave suggestions for improving services in suggestion boxes in the hospital. Also, upon leaving the hospital, patients might be asked to fill out questionnaires voicing approval or disapproval of various aspects of the hospital's program. Another method of getting this information is to work through schools, churches or other community organizations to get questionnaires completed with respect to likes and dislikes of the hospital.

The administrator needs to have some knowledge of survey design to use these surveys successfully or a consultant might be employed on a limited scale. In addition to providing useful information these surveys may serve as a public relations medium. Perhaps they will get people to thinking about the hospital and make them feel that the hospital is concerned with their feeling toward the way it is performing its role.

Another index of acceptance is the amount and type of gossip and rumors which one hears in the community about the hospital. One administrator said that this was the biggest obstacle which his hospital had to overcome in winning acceptance among the general public. These rumors may arise out of dissatisfaction with the way the hospital is performing its services or with some other aspects of the hospital.

In one community, for example, there were rumors that preferential treatment was given certain elements in charity care; that the staff of the hospital was incompetent, and that political figures dominated the administrator. The source of rumors of this sort is frequently hard to determine, and the administrator may never know of the rumors himself. However, each administrator should employ methods to project a favorable image of his hospital to the public. This may be done through the local press, speeches to civic clubs or other community organizations, and the personal influence of employees and other persons connected with the hospital.

In the field studies it was found that persons who remembered reading articles about the hospital in the county paper expressed more favorable attitudes toward the hospital than persons who could not remember reading about the hospital. Also persons who had attended a club meeting where the hospital was discussed as a part of the program expressed significantly more favorable attitudes toward it than persons who had not attended such a meeting.

Former patients are also important means of projecting a favorable image of the hospital to the community. One satisfied customer is perhaps worth a million words. Therefore, the hospital should strive to satisfy the patient's needs insofar as possible. In many cases this will include the satisfaction of basic emotional and psychological needs in addition to routine nursing care, food, cleanliness and diagnosis. In one community, persons were asked why they continued to use an obsolete proprietary hospital when by their own admission the county hospital had better equipment, a nicer plant, and offered more sophisticated services. The answers revealed that the nurses in the proprietary hospital treated the person like a baby, that they seemed more interested in him as a person than as a patient, and that a homelike atmosphere was maintained.

The study has revealed that rural residents in Mississippi expect some degree of informality and "folkness" from the hospital, and when the rural hospital becomes too sophisticated patients and their families begin to complain. This desire for folkness is part of the "expectation complex" which potential patients, who until recently dealt with all but major illness in their home, have of the hospital. Of course, the degree to which a hospital fulfills the expectations of its patients is associated with the degree of acceptance and satisfaction of the hospital. Talks with patients and their families may give the administrator some indication of the expectations of his hospital. The efficient administrator must then decide how to adjust performance to expectation, or vice versa.

A final index of acceptance among the general public is the amount of support which residents of the hospital's service area give the hospital in comparison to support given other institutions. In the case of Hill-Burton hospitals this includes tax support as well as use and contributions. Willingness to support the hospital through one means may not mean willingness to give whole hearted support. In one county, for example, residents of one neighborhood remarked that they liked the hospital and would use it, but that they would not support any move to add to the plant or equipment as long as Mr. X remained on the board of trustees. It was a common tendency for persons to indicate willingness to support the hospital in every way except through increased taxes. The reason for this feeling in most cases was misunderstanding of the obligation of tax support to maintain the hospital or to improve its plant and services. In many cases this condition could be overcome with a good public information program. The administrator needs to know what conditions stand in the way of a willingness to assume financial support before he can try to overcome the condition. Working through neighborhood influentials is one good way to get this information.

It is not common for Hill-Burton hospitals to ask for support in the form of contributions. However, several hospitals have asked for contributions from persons and groups in their service area. One hospital involved the churches and other community groups in a fund raising campaign to build and equip a small chapel in the hospital, and to provide other services which lay outside of the area of hospital care. Also in one case the hospital auxiliary asked persons for surplus produce from home gardens to be used in the hospital kitchen. In both cases the involvement of persons and groups in this type of support served as a public relations device. Anytime persons and groups are made aware of the need of the hospital and respond favorably, the administrator can be assured that he has elicited a stronger commitment of support in the long run.

## The Board of Trustees

Outside of the general public probably no groups are more important to the success of the Hill-Burton hospital than the board of trustees and the board of county supervisors. Administrators frequently judge their effectiveness with these groups by their support in financial matters, and in making and implementing policy. However, it should be remembered that these groups are closer to the general public than are some other groups and they can have a tremendous influence on the success of the administrator and the hospital among the larger public.

Perhaps one of the biggest problems of the new county hospitals is a clear definition of the role of the trustee in the operation of the hospital. In many communities the county hospital is perceived by the board of trustees, the board of county supervisors, and a large proportion of the general public as being a sort of Jeffersonian bureaucracy. Thus, in these counties the board of trustees may want to assume more power in the daily operation of the hospital than is rightly theirs. In one county, for example, it was felt that the board of trustees wanted to keep a weak administrator at the hospital so that, as they put it, they could "run" the hospital.

In most cases members of the board of trustees have little information about hospital administration. Therefore, if they are to have more than a nominal role, some means must be taken to inform this group. This would include information with respect to the role of the hospital as a business organization as well as a community service organization. It is the belief of the research team that one of the most urgent needs of the new county hospitals is some standard procedure to recruit board members, to indoctrinate them once they are chosen, and to provide for some sort of continuing education once the program is begun.

## Hospital-Physician Relations

The physician is one of the key persons in the promotion of the hospital. This study has shown that a large percentage of persons will choose a particular hospital because their doctor uses it. Thus, when there is a choice in a community the decision is made on the basis of the hospital which the family physician uses. Also if a family must use a hospital outside the community they generally follow the recommendation of their family physician on where to go, what specialist to consult, and what hospital to use.

There is evidence that persons place more confidence in their physician than in the hospital. Thus, even mild criticism of the hospital by a physician in the presence of patients may create an unfavorable impression of the hospital in the eyes of the patient. In one community it was found that former patients of a particular physician were almost always critical of the local hospital. A check showed that this physician[1] had been very critical of the hospital for personal reasons. This in turn had influenced his patients. However, many of these patients said that their opinion had changed when they changed doctors or when they had personal experience with the hospital.

In another community the hospital was criticized for its failure to render charity care. According to the administrator and the board of trustees, the hospital and the physicians in the community had agreed upon this policy because there was evidence that all persons in the county could afford to pay for treatment. However, it appeared to the research team that neither the hospital nor the physicians were willing to assume responsibility for the decision and that both placed the blame upon the other when the general public began to complain. There is evidence also that patients do not know whom to blame for minor dissatisfaction with respect to service and diagnosis, and such things as visiting hours and other regulations. It is easy for the hospital as well as the doctor to shift the blame to the other unless a satisfactory arrangement for handling complaints is worked out.

It is therefore encumbent upon the administrator to maintain favorable relationships with the medical staff. The personality of the physician and of the administrator may bear upon this problem. However, administrators must be able to identify potential areas of conflict between themselves or the hospital and its medical staff. Policies must be established jointly by the medical staff and the administrator if they are to be satisfactory to both parties. Also communication between the two levels must flow freely so that conflict is made apparent and can be resolved, and each party must be willing to assume its obligations as well as rights. All persons involved in medical and hospital care have a stake in the hospital. Therefore, a regular review of its status together with a consideration of internal and external problems is of importance to all concerned.

### Local Community Leaders and Hospital-Community Relations

Any program designed to create a major change in the status of the hospital in the community will require a long period of time to accomplish. It will also need the support of community leaders who exert their influence through informal channels as well as those who are easily identified as community leaders by virtue of their positions in formal community organization. Obviously to secure the support of the community power structure one must be able to identify persons who have influence. This may be no easy task in view of the fact that the persons with the most power may not hold any formal positions of influence in the community. However, the effective administrator will be concerned with the identity of power holders and will discern the most effective way to work through the existing structure.

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[1] This doctor is no longer engaged in the practice of medicine in the state.

Failure to win support of community influentials has spelled defeat for expansion programs of some hospitals as well as programs of a more general nature involved in the day to day operation. Also in some cases administrators have become involved in power struggles between factions in the community when the positions of power holders were threatened or the power structure was being questioned. In cases of this sort the identification with factions is to be avoided. Administrators in several small Mississippi communities have discovered the ill effects which can accrue when the administrator and the hospital become involved in local politics. There is no magic formula for working with the community power group. However, administrators must be aware of its importance and manipulate it to the hospital's advantage.

### Persons and Groups Interested In Community Welfare

There are many persons and groups in every community who are interested in welfare. These groups may have governmental connection such as the county health and welfare departments, or they may be local groups, such as churches and civic clubs which have welfare programs as a part of their overall program. Each of these groups, is either directly or indirectly a partner of the hospital in providing services which are essential to the welfare of the community. Also many of them serve as the connecting link between the hospital and a large segment of the general public.

As a community service institution Hill-Burton hospitals have an obligation to render some charity care. Close cooperation between the hospital and such groups as the county health and welfare departments can be beneficial to all groups concerned in handling charity cases. Health and welfare departments frequently wish to recommend persons to the hospital or a medical doctor for charity care. On the other hand, the cautious administrator may sometimes desire the help of the welfare department or other groups in establishing eligibility of some charity patients.

Certainly all groups concerned with welfare can be of benefit to the hospital in formulating and publicizing policy with respect to charity. This is another of the major needs of Mississippi hospitals. Many persons have the notion that all Hill-Burton hospitals are charity hospitals. Some people who are able to pay expect free services. Some administrators have attempted to solve this problem by refusing charity patients. However, this policy appears to be more detrimental than beneficial to the hospital. One hospital which followed this policy was not at all popular among the substantial middle class element in the county. Stories were told of several deaths which occurred because the hospital refused to render charity care to dying patients, and of embarrasing incidents to middle class persons who were suspected of wanting charity care. Whether or not these stories are true was not determined. However, the hospital has suffered and will probably continue to be held in low esteem by a sizeable proportion of the population until a reasonable policy with respect to charity is formulated and publicized.

Other persons and groups interested in welfare may be beneficial to the hospital if handled properly. One such group is the ladies in the community who are interested in the hospital auxiliary. These ladies are generally higher status persons who desire some channel through which they can render a welfare service to the community. They have resources in the form of time, talent, and sometimes money which the hospital can use to an advantage. Also they are either a part of, or close to, the community power structure and can influence the status of the hospital at that level.

If the administrator cannot work harmoniously with the auxiliary, however, it may do his hospital more harm than good. One hospital studied had a large and ambitious auxiliary, but the administrator's relationships with the auxiliary members were strained. Hence, the auxiliary spent a large part of its time criticizing the administrator and the hospital. Another administrator spoke of unfavorable experiences with the auxiliary. This administrator thought that civic clubs, churches and other groups interested in welfare could be used more effectively to perform some of the tasks ordinarily performed by the auxiliary. He saw an additional advantage in this arrangement because he said these groups do not become as deeply involved in the day to day operation of the hospital as the auxiliary does. Therefore, he does not have to justify his administration to these groups as he would to the auxiliary nor does he worry about these groups spreading detrimental gossip. It appears that the auxiliary can be a dynamic force in performing tasks which are not a part of the hospital's daily program and in promotion of the hospital in the community. However, unless the administrator has a well defined and useful program for the auxiliary he may find that its disadvantage outweighs the advantages.

### Literature Available on Hospital-Public Relations in Mississippi

The materials in this report were taken in part from the following sources Interested persons may obtain copies of the publications, preceded by an asteric by writing the Division of Sociology and Rural Life, Mississippi State University, State College, Mississippi.

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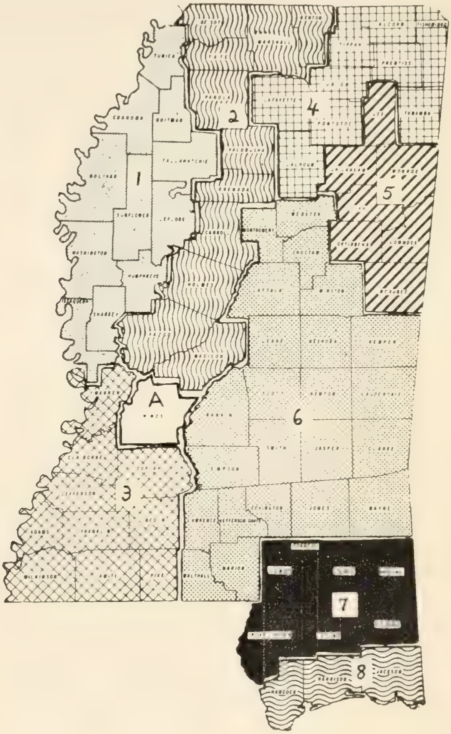
BULLETIN 648 JULY 1962

# Rural Nonfarm Families In The Clay-Hills Of Mississippi

# Incomes and Resources



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## Highlights

The number of rural nonfarm families in the Clay-Hills Area is increasing rapidly while the number of farm families is declining. There are two distinct groups of rural nonfarm families: those families who depend primarily upon off-farm work income for their livelihood, and those families who depend primarily upon income transfer payments, rents, and retirements for their livelihoods.

Members of the first group generally are younger and have had more formal education than those in the second group and for the most part their net money incomes per family is more than $2,000 a year. The farm contribution to family living in the form of housing and products produced for home consumption were important income items for the retired and semi-retired group but relatively unimportant items for the off-farm employed group. Many of the families in both groups owned sizable tracts of land which for the most part were not being utilized.

Families with off-farm employment utilized almost three times as much of their available labor as the families depending on nonwork income. The degree of utilization of the available family labor supply and family net money income was closely associated.

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The data presented in this study are taken from a field survey of 517 rural families in the Clay-Hills Area of Mississippi in 1958. This study is part of the research conducted in support of the Rural Areas Development Program.

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# RURAL NONFARM FAMILIES IN THE CLAY HILLS OF MISSISSIPPI — INCOMES AND RESOURCES

By Herbert Hoover and John C. Crecink*

## INTRODUCTION

Population trends in the Clay-Hills Area of Mississippi have been toward a decided increase in proportion of rural nonfarm residents in the past few years, even though the area is still predominantly agricultural. The total number of rural residents in the area reached a peak in 1940 and has declined since that time. Farm population has decreased by half since 1930, while urban and rural nonfarm populations have doubled and tripled respectively.

Farm population in the area declined from an estimated 278,000 to an estimated 147,000 (a 47 percent decrease) during the period 1940-1959. The estimated number of rural nonfarm families increased during the same period from about 22,000 to about 60,000 (a 173 percent increase).[1]

The decline in farm population and the accompanying increase in rural nonfarm population are expected to continue for some time. It could well be that in the not too distant future rural nonfarm population will predominate, provided nonfarm job opportunities continue to exist that will absorb the off-farm migration.

Need for separate study of the rural nonfarm group arises because the low incomes that are common in the group are related to characteristics of families and resources they control. To more fully understand the causes of low income of these families, it is necessary to determine the nature and extent of their physical and human resources. On the basis of these determinations, their adjustment potentials can then be evaluated.

The study reported here was directly concerned with the 217 rural families included in a larger study of 517 sample rural families in the Clay-Hills Area in 1957-58.[2] None of the 217 families conducted a farming operation that grossed as much as $150.

Rural nonfarm families can be classified into two distinct groups according to their sources of income: (1) those families that depended primarily upon off-farm work income and, (2) those families that depended primarily upon nonwork income.

Of the 217 rural nonfarm families in the sample, 109 were in the group with off-farm employment and 108 were in the nonwork income group. The nonwork income group can be further separated into two additional classes: (1) those who depended primarily upon transfer payments and family support[3] (73 families), and (2) those who depended primarily upon rental income and retirement[4] (35 families).

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*Agricultural Economists, Farm Economics Division, Economic Research Service, U. S. Department of Agriculture cooperating with the Mississippi Agricultural Experiment Station.

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[1] Computed from the 1940 and 1960 Censuses of Population.

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[2] Data collected in fall of 1957 and spring of 1958 by personal interviews in Census Economic Areas 4 and 6b of Mississippi. The overall study is Production Problems of Low Income Farmers in the Clay-Hills of Mississippi."

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[3] Old age payments, aid to dependent children, payments to the handicapped (blind), support from children and other family members, and savings.

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[4] Rental income from farm and nonfarm property, private pension and retirement plans, railroad retirement, military retirement and pensions, Social Security payments, and other such income.

## FAMILY CHARACTERISTICS

The particular physical characteristics of a family not only are a determinant of family income but are also indicative of the adjustment potential for improving incomes that the family possesses, even when economic opportunities are present. Family characteristics such as age and formal education of the family head, and size, age, education, and sex of other family members not only strongly influence present family income but also affect the ability of the family to make adjustments that may increase income.

**Age and education by family class:** The family characteristics of the two major groups were quite different. For example, the nonwork-income family heads averaged 67 years of age, and had had a little over 5 years of formal schooling. In contrast, the off-farm work family heads averaged only 40 years of age and they had had almost 9 years of formal schooling.

It is rather obvious that families with a low income problem are concentrated in the nonwork income class. Generally speaking, these families are headed by individuals who are aged, poorly educated, and in many instances physically handicapped. Consequently, possibilities for improving their incomes through adjustments in employment are restricted. On the other hand, the families with off-farm employment are for the most part presently earning more than $2,000 net money income and the economic pressure to raise incomes is not as great as in the case of the nonwork income families. This does not mean that families with off-farm employment do not need to improve their income status.

**Size and type of family:** Families with off-farm employment generally had more individuals per household than the nonwork income families. This is to be expected because of the difference between the two groups in age of family heads. Many households in the nonwork income group consisted of only one person, and

Table 1.—Number of families, average age and education of family head, and average net money income per family by family class.

| Family classification | Families | Average age of family head | Average education of family head | Average net money income of family |
|---|---|---|---|---|
| | Number | (Years) | (Years) | (Dollars) |
| All families | 217 | 53 | 7 | 2013 |
| Off-farm employment | 109 | 40 | 9 | 3080 |
| Nonwork income | 108 | 67 | 5 | 937 |
| Transfer payments | 73 | 70 | 4 | 738 |
| Rentals and retirements | 35 | 61 | 7 | 1353 |

Table 2.—Major source of income, by size of family, 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.

| Individuals per family | Off-farm work families | Nonwork income families | | | Total all families |
|---|---|---|---|---|---|
| | | Transfer payments | Rental & retirement | total | |
| | Number | Number | Number | Number | Number |
| 1 | 3 | 16 | 6 | 22 | 25 |
| 2 | 34 | 40 | 14 | 54 | 88 |
| 3 | 22 | 10 | 8 | 18 | 40 |
| 4 | 16 | 2 | 4 | 6 | 22 |
| 5 | 10 | 3 | 1 | 4 | 14 |
| 6 | 14 | 1 | 2 | 3 | 17 |
| 7 and over | 10 | 1 | | 1 | 11 |
| Total | 109 | 73 | 35 | 108 | 217 |

**Table 3.—Major sources of income, by family type, 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.**

| Family type[1] | Off-farm work families | Nonwork income families |  |  | Total all families |
|---|---|---|---|---|---|
|  |  | Transfer payments | Rental & retirement | total |  |
|  | Number | Number | Number | Number | Number |
| Type I | 66 | 1 | 3 | 4 | 70 |
| Type II | 32 | 9 | 8 | 17 | 49 |
| Type III | 5 | 61 | 22 | 83 | 88 |
| Type IV | 6 | 2 | 2 | 4 | 10 |
| Total | 109 | 73 | 35 | 108 | 217 |

[1] Type I families—Those with head of household under 45 years of age and having no occupational handicap.

Type II families—Those with head of household 45 to 64 years of age and having no occupational handicap.

Type III families—Those with no employable male 18 to 64 years of age.

Type IV families—Those with a female household head but with one or more employable males 18 to 64 years of age.

**Table 4.—Race of family: Number in each family class and average family net money income, 217 rural nonfarm families, Clay-Hills Area of Mississisippi, 1958.**

| Race | Off-farm work families |  | Nonwork income families |  |  |  | Total all families |  |
|---|---|---|---|---|---|---|---|---|
|  |  |  | Transfer payments |  | Rental & retirement |  |  |  |
|  | No. | Dol. | No. | Dol. | No. | Dol. | No. | Dol. |
| White | 98 | 3,139 | 63 | 769 | 30 | 1,417 | 191 | 2,087 |
| Nonwhite | 11 | 2,556 | 10 | 539 | 5 | 974 | 26 | 1,476 |
| Total or average | 109 | 3,080 | 73 | 737 | 35 | 1,354 | 217 | 2,014 |

two-thirds consisted of two members or less. In contrast two in three of the families with off-farm employment had more than two members per household (Table 2).

In the model type family with off-farm employment, the family head was under 45 years of age, and had no occupational handicap (Table 3). On the other hand, the modal type of nonwork income family had no employable males 18 to 64 years of age. These data on family employability tend to substantiate the conclusion that the nonwork income families are extremely limited in employment possibilities.

**Race:** The proportion of white to nonwhite rural nonfarm families in the Clay-Hills was nine to one. There was no statistical difference in the ratio of whites and nonwhites who had off-farm work, or who depended primarily upon transfer payments or rental and retirement income for a livelihood. One out of two rural nonfarm white families were off-farm employed and two out of five nonwhite families had off-farm employment (Table 4). However, there were significant differences between age and education of the household heads, white household heads were older and had more formal education than nonwhites, and family net money income. In each family class nonwhite families averaged less net money income than did white families. White families received on the average $2,087, nonwhite families only $1,476.

## FARM CONTRIBUTIONS TO FAMILY LIVING

Nonfarm families live in rural areas by choice, out of a feeling of necessity, or for a combination of these two reasons. Families may be boxed in or forced to remain in rural areas because of mobility restrictions resulting from many causes, such as inability to recover their investment, family obligations, lack of capital to finance a move, or psychological fear of not being able to adjust to town or urban living conditions. Such families generally do not attach any real value to living in rural areas.

Nonfarm families who remained in the rural area out of choice usually gave the following reasons: (1) advantages of raising a family in a rural environment; (2) feeling of security in such things as social ties, standing in the community, sense of belonging, and family, and religious ties; and (3) lower cost of rural living resulting from lower costs of such things as housing (rents), social obligations and incidental expenses related to these obligations, and home raised food. The primary disadvantage named, particularly by families with off-farm employment, was the cost of transportation to and from the job. Formerly, the problem of schools for children was a disadvantage, but with widespread consolidation of school districts throughout the area it is no longer mentioned as a disadvantage in most areas.

**Family housing and home conveniences:** Housing of rural nonfarm families in the Clay-Hills was primarily of frame construction and in fair to good condition[5]. Variations in type, size, and age of the house, and in conveniences within the home were found between the off-farm employed and the nonwork income groups (Table 5). These differences generally can be attributed to the difference in average family age. Heads of the families with off-farm work were younger, the families had not resided at the same place as long, and usually there were young children in the family. In general, homes of the off-farm work group were newer, larger, and had more modern conveniences (that is, inside plumbing, home freezers, television, washing machines, etc.) than homes of the nonwork income group. For example, 56 percent of the houses of families with off-farm employment were judged to be good to excellent in quality but only a third of the houses of the nonwork income group were considered to be in these categories. Both groups, however, had better housing and more home conveniences than full-time

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[5] Condition of house based upon respondents' evaluation and upon enumerator's observation and evaluation.

Table 5.—Age and condition of housing and type of plumbing facilities, 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.

| Family class and condition of dwelling[1] | Total | Age of dwelling (years) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Less than 10 | | 10 to 24 | | 25 to 49 | | 50 and over | |
| | | Inside plumbing | | | | | | | |
| | | Yes | No | Yes | No | Yes | No | Yes | No |
| | Number of families | | | | | | | | |
| Off farm work | | | | | | | | | |
| Excellent | 17 | 12 | — | 3 | — | 1 | — | 1 | — |
| Good | 44 | 13 | 6 | 10 | 9 | 2 | 2 | 2 | — |
| Fair | 28 | 2 | 5 | 3 | 7 | 3 | 2 | 1 | 5 |
| Poor | 20 | 1 | 3 | — | 3 | — | 3 | 1 | 9 |
| Total | 109 | 28 | 14 | 16 | 19 | 6 | 7 | 5 | 14 |
| Nonwork income | | | | | | | | | |
| Excellent | 7 | 4 | — | 2 | — | 1 | — | — | — |
| Good | 29 | 5 | 9 | 4 | 1 | 3 | 3 | 1 | 3 |
| Fair | 38 | — | — | 5 | 11 | 1 | 11 | 6 | 4 |
| Poor | 34 | — | 3 | — | 7 | — | 10 | 1 | 13 |
| Total | 108 | 9 | 12 | 11 | 19 | 5 | 24 | 8 | 20 |

[1] Condition of housing based upon respondents' evaluation and upon enumerator's observation and evaluation.

**Table 6.—Percentages of homes with specified conveniences by family class, 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.**

| Home conveniences | Rural nonfarm families | | | |
|---|---|---|---|---|
| | Off-farm work group | Nonwork income group | | |
| | | Transfer payments | Rental & retirement | Total |
| | Percent | | | |
| Electricity | 97 | 90 | 94 | 94 |
| Telephone | 27 | 12 | 6 | 18 |
| Elec. refrigerator | 93 | 84 | 94 | 90 |
| Television | 64 | 22 | 51 | 48 |
| Radio | 90 | 86 | 86 | 88 |
| Home Freezer | 30 | 15 | 26 | 24 |
| Inside piped water | 49 | 23 | 43 | 39 |
| Inside bath | 39 | 16 | 31 | 30 |
| Water heater | 39 | 16 | 29 | 29 |
| Washing machine | 41 | 38 | 54 | 42 |
| Elec. or gas stove | 86 | 63 | 80 | 77 |

**Table 7.—Number of families producing food for home use by family class , 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.**

| Family class | Families Reporting | | | | Value per family reporting | Average value all families |
|---|---|---|---|---|---|---|
| | No production | | Production | | | |
| | No. | Percent | No. | Percent | Dollars | Dollars |
| Off-farm work | 59 | 54 | 50 | 46 | 280 | 128 |
| Nonwork income | 39 | 36 | 69 | 64 | 233 | 149 |
| Transfer payment | 30 | 61 | 43 | 59 | 222 | 131 |
| Retirement | 9 | 26 | 26 | 74 | 250 | 186 |
| Total or average | 98 | 45 | 119 | 55 | 253 | 138 |

[1] Farm-produced products used in the home consisted of livestock products (eggs, milk, and butter), meats (beef, pork, and poultry), vegetables, fruits, other crops, and firewood.

farm families[6]. Due to activities of T.V.A. and the R.E.A. Cooperatives, almost all (95 percent) rural nonfarm families in the Clay-Hills had electricity in their homes (Table 6).

**Consumption of home produced farm products:** One of the amenities usually associated with rural living is the possibility of producing farm products for use in the home. However, nearly half of the rural nonfarm families in the Clay-Hills Area did not capitalize on this income source. Only 119 of the 217 families reported that they produced farm products for home consumption, and the estimated average annual value of these products was $253 (Table 7). The relatively low percentage of families who produced farm products for home consumption, and the relatively small value of food so produced suggests that, generally speaking, this item does not weigh too heavily in the decision of members of the off-farm work groups to remain in rural areas. On the other hand, for the retired and semi-retired group it is evidently a very real consideration, for nearly three-fourths of these families grew some of their food. Although the value realized was relatively low, it constituted an important part of the family income for retired and semi-retired groups and of welfare groups. In the case of the off-farm work group it was a relatively unimportant item. One explanation for the difference in importance of the enterprise to the family classes could well be the almost complete lack of alternative employment opportunities open to retired and semi-retired families. In other words, the opportunity cost of these families' labor would approach zero.

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[6] Based upon examination of data on housing for all family classes contained in the overall study. Condition of housing based upon respondents' evaluation and upon enumerator's observation and evaluation.

## LAND RESOURCES CONTROLLED

Although only one-fourth of the 217 rural nonfarm families were tenants, 54 percent of the families controlling only a house and lot (two acres of land or less) were renters (Table 8). Over the years, migration of families from the area has resulted in an excess of housing. Admittedly, much of this excess is substandard by present day criteria, but it is available at very low cost. This has evidently induced many nonfarm families to remain in or move to the rural areas. Another explanation for the high tenancy rate among families with only a house and lot is that many of the family heads were formerly tenant farm operators who continued to rent the house although in most instances they no longer rented the farm land. The opportunity cost of such houses to the landlords approaches zero because of (1) the low salvage value of the houses themselves and (2) the lack of alternative economic uses for the houses. In any event, there are many vacant houses throughout the area that presumably could be rented for very little.

Slightly more than half (54 percent) of the rural nonfarm families have or control sizable land holdings. These lands have been effectively withdrawn from agriculture. They have reverted to idle lands and are being allowed to grow up in brush and timber with little or no management. For example, rural nonfarm families owned an average of 75 acres of land, of which only 13 acres were rented out. The average amount of acreage rented out is misleading to some extent because 56 percent of these families rented out none of their lands. These families controlled, on the average, 64 acres of land which for the most part was lying idle.

Most families owning the farms on which they live were formerly farm operators. These lands are not being transferred, either through sale or rental, to active farmers. Nor, in 1958, had they been placed in the soil bank or conservation reserve program. The extremely low cost of ownership under the Mississippi Homestead Tax Exemption Law evidently contributes to the non-transfer of land. Lands rented out cannot legally be claimed as part of the homestead. Therefore, rented acreages are subject to taxation at a much higher rate than homestead exempt property. Income from rent evidently would not be enough to compensate the land owner for the increase in taxation if the lands are rented out. Data from the larger study indicated that most rental land is owned by absentee owners who are not entitled to homestead exemptions.

One cause of the low income farm problem in the Clay-Hills Area is the existence of small, low productivity farms. Data on the rural nonfarm families suggests that one of the problems

Table 8.—Number of families owning or renting, and average acreage controlled, by family class, 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.

| Family classification | Families in sample | Average acreage controlled | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Two acres or less | | More than two acres | | | | |
| | | Owned | Rented | Families | Owned | Rented in | Rented out | Total |
| | Number | Number | Number | Number | Acres | Acres | Acres | Acres |
| Off-farm work | 109 | 24 | 25 | 60 | 43 | 3 | 4 | 42 |
| Nonwork income | 108 | 21 | 29 | 58 | 109 | [1] | 23 | 86 |
| Welfare | 73 | 16 | 24 | 33 | 80 | [1] | 12 | 69 |
| Retired | 35 | 5 | 5 | 25 | 146 | | 37 | 109 |
| All classes | 217 | 45 | 54 | 118 | 75 | 2 | 13 | 64 |

[1] Less than one-half acre.

in recombining acreages into adequate size farm units is the acreage owned by these families. Many are reluctant to part with their lands because of: (1) the high value they placed upon land ownership, (2) the desire to hold land as a hedge against loss of income from nonfarm employment, and (3) the value of the acreage as an investment — which the farmer or ex-farmer best understands —toward retirement. These factors tend to inhibit the recombination of resources necessary for improving agricultural income in the area.

## FAMILIES WITH OFF-FARM EMPLOYMENT

In 1958, for one in two rural nonfarm families in the Clay-Hills Area of Mississippi, employment off the farm was the major source of income. In most instances, only the head of the household worked off the farm, but occasionally the wife or other family members did so. In terms of aggregate dollar income, off-farm work was more than three times as important as all other sources of income combined.

Families in the off-farm-work group had net money incomes considerably above those of other rural nonfarm families in the area; the average income of the off-farm-work group was $3,080 compared with only $937 for the nonwork income group (Table 9). Also, despite the fact that off-farm work families were larger, their per capita net money incomes were more than twice those in the nonwork income group.

**Labor availability and utilization:** As a whole, utilization of family labor was found to be relatively low. In 1958, the average off-farm work family had an estimated labor supply of 4,389 hours, and the average nonwork income family had an estimated labor supply of only 1,940 hours.[7] Families with off-farm employment, however, utilized, on the average, 61 percent of their available labor, whereas the nonwork income families utilized only 21 percent.

The relationship between the degree of family labor utilization and net family money income was positive. That is, generally speaking, the higher the percentage of labor utilized, the higher the family net money income. For example, two-thirds of the 24 off-farm work families who utilized 80 percent or more of their labor had net family money income of $3,000 or more. However, two families utilized 100 percent or more of their labor and had incomes of less than $3,000. These two instances can be explained by the absence of an employable male adult in either family.[8]

**Age and education:** Households with family heads of middle age (35-54 years of age) had slightly higher income than

Table 9.—Net money income by family class, 217 rural nonfarm families, Clay-Hills Area of Mississippi, 1958.

| Family class | Families | Net money income: Average per family | Net money income: Per capita |
|---|---|---|---|
| | No. | Dollars | Dollars |
| Off-farm work | 109 | 3080 | 805 |
| Nonwork income | 108 | 937 | 394 |
| Transfer payments | 73 | 738 | 322 |
| Rentals and retirements | 35 | 1353 | 526 |
| All nonfarm | 217 | 2013 | 648 |

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[7] Crecink, John C., "Incomes, Resources and Adjustment Potential of Rural Families in the Clay-Hills Area of Mississippi," Mississippi Agricultural Experiment Station, AEc. M. R. No. 29.

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[8] Women were considered as utilizing their labor 100 percent, whether they worked full-time or part-time off-farm.

households with younger or older family heads, (Table 10). Fifty percent of families with middle-aged heads earned $3,000 or more, but only 36 percent of those with younger family heads and 40 percent of those with older family heads earned $3,000 or more. However, among families with less than $2,000 net money income little association appeared between age of family heads and incomes.

A positive relationship existed between the educational level, as measured by the number of years of school completed, of the family head and family income. Generally speaking, the higher the level of education attained by the family head the higher the level of family net money income. For instance, two-thirds of those family heads receiving less than $2,000 net money income had had 8 years or less of formal schooling, whereas heads of almost three-fourths of those families receiving $5,000 or more income had heads receiving 9 years or more of formal schooling.

**Occupations:** Most common types of

Table 10.—Specified family characteristics and net family money incomes, 109 off-farm employed families, Clay-Hills Area of Mississippi, 1958.

| Family characteristics | Net family money income<br>Under $1000 | <br>$1000 to 1999 | <br>$2000 to 2999 | <br>$3000 to 3999 | <br>$4000 to 4999 | <br>$5000 and over | <br>Total |
|---|---|---|---|---|---|---|---|
| | | | ———Number——— | | | | |
| Families | 6 | 22 | 33 | 19 | 15 | 14 | 109 |
| Age of family head | | | | | | | |
| Under 25 | 1 | 1 | 6 | 1 | 1 | 1 | 11 |
| 25 to 34 | -- | 7 | 8 | 3 | 3 | 4 | 25 |
| 35 to 44 | 1 | 6 | 8 | 8 | 8 | 1 | 32 |
| 45 to 54 | 2 | 5 | 7 | 4 | 2 | 6 | 26 |
| 55 to 64 | 2 | 2 | 4 | 2 | 1 | 1 | 12 |
| 65 and over | - | 1 | -- | 1 | -- | 1 | 3 |
| Years of schooling completed | | | | | | | |
| Under 5 | 2 | 7 | 2 | 1 | 2 | -- | 14 |
| 5 to 6 | 2 | 2 | 1 | -- | 3 | 1 | 9 |
| 7 to 8 | 1 | 6 | 15 | 4 | 1 | 3 | 30 |
| 9 to 11 | 1 | 6 | 8 | 4 | 5 | 4 | 28 |
| 12 | -- | -- | 4 | 5 | 3 | 5 | 17 |
| 13 and over | -- | 1 | 3 | 5 | 1 | 1 | 11 |
| Race | | | | | | | |
| White | 6 | 19 | 29 | 18 | 13 | 14 | 99 |
| Nonwhite | -- | 3 | 4 | 1 | 2 | -- | 10 |
| Occupation of family head | | | | | | | |
| Professional and technical | -- | -- | 2 | 3 | -- | 1 | 6 |
| Managers, officials and proprietors | -- | -- | -- | 1 | 2 | 2 | 5 |
| Clerical and sales | -- | 1 | 1 | 1 | 1 | -- | 4 |
| Craftsmen | -- | 1 | 9 | 7 | 3 | 4 | 24 |
| Operative | -- | 6 | 4 | 1 | 5 | 3 | 19 |
| Private household | -- | 1 | -- | -- | -- | -- | 1 |
| Services | -- | 1 | 4 | 2 | -- | 3 | 10 |
| Laborer (farm and nonfarm) | 6 | 12 | 13 | 4 | 3 | 1 | 39 |
| Military service | -- | -- | -- | -- | 1 | -- | 1 |
| Percent of family labor supply utilized | | | | | | | |
| Under 20 | 2 | -- | 1 | -- | -- | -- | 3 |
| 20 to 39 | 2 | 1 | 4 | 3 | -- | 1 | 11 |
| 40 to 59 | 2 | 6 | 6 | 5 | 6 | 2 | 27 |
| 60 to 79 | -- | 11 | 18 | 8 | 4 | 3 | 44 |
| 80 to 99 | -- | 3 | 3 | 3 | 4 | 8 | 21 |
| 100 and over | -- | 1 | 1 | -- | 1 | -- | 3 |

**Table 11.—Distance traveled to work, by type of employment, 109 off-farm employed families, Clay-Hills Area of Mississippi, 1958.**

| | Occupation | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Distance traveled to work | Professional and technical | Managers, officials, and proprietors | Clerical and sales | Craftsman | Operative | Service | Laborer (farm & non-farm) | Total |
| Total | 6 | 5 | 4 | 24 | 19 | 12 | 39 | 109 |
| Less than one mile | 1 | 3 | -- | 1 | 4 | 2 | 5 | 16 |
| 1-4 miles | 4 | 1 | 1 | 5 | 4 | 5 | 9 | 29 |
| 5-9 miles | 1 | -- | 3 | 9 | 3 | 2 | 11 | 29 |
| 10-14 miles | -- | -- | -- | 4 | 4 | 2 | 4 | 14 |
| 15-24 miles | -- | 1 | -- | 1 | 1 | 1 | 7 | 11 |
| 25-49 miles | -- | -- | -- | 4 | 2 | -- | -- | 6 |
| 50 or more miles | -- | -- | -- | -- | 1 | -- | 3 | 4 |

**Table 12.—Stability of employment of household heads by specified age grouping, 109 off-farm employed families, Clay-Hills Area of Mississippi, 1958.**

| Tenure of employment (years in present job) | Age of household head | | | | | | | | | | | | Total all family heads |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Under 45 years | | | | 45-54 years | | | | 55 years and over | | | | |
| | Number of jobs held[1] other than farming | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 or more | 1 | 2 | 3 | 4 or more | 1 | 2 | 3 | 4 or more | |
| | Number | | | | | | | | | | | | |
| 1-3 | 13 | 8 | 6 | 5 | 1 | 1 | 2 | 2 | 1 | -- | -- | -- | 39 |
| 4-9 | 16 | 4 | 4 | 1 | 3 | 1 | -- | 3 | 2 | 4 | -- | -- | 38 |
| 10-19 | 9 | 1 | -- | 1 | 7 | 2 | 1 | -- | -- | 2 | 1 | -- | 24 |
| 20 or more | 1 | -- | -- | -- | 3 | -- | -- | -- | 1 | 3 | -- | -- | 8 |
| Totals | 39 | 13 | 10 | 7 | 14 | 4 | 3 | 5 | 4 | 9 | 1 | -- | 109 |

[1] Employment lasted 6 months or more.

off-farm employment were common labor (39 percent), crafts (24 percent), and operative (19 percent). Generally, the higher the degree of skill of the family heads, the higher the net family money income. The majority of the family heads receiving $5,000 or more were skilled or semi-skilled workers; two-thirds of those receiving less than $2,000 were common laborers (farm or nonfarm).

In 31 of the 109 families with off-farm employment, two or more individuals worked off-farm. Three in four of these 31 families earned over $3,000 net money income and one in three earned over $5,000. In two-thirds of those families earn ing net money incomes of $5,000 or more, two or more individual members were off-farm employed.

**Distances traveled to work:** Workers in the off-farm work group traveled, on the average, 10 miles one way to their places of employment. Usually, laborers, operatives, and craftsmen traveled greater distances to their places of employment than did workers in other trades, (Table 11). The latter group usually had had more education than the former group, indicating that the non-skilled workers had to travel much greater distances to find employment. Travel to and from work is a cost item that reduces net income—the greater the distance the greater the cost. By and large the laborers, operatives, and craftsmen received less compensation for their labor and incurred greater transportation cost than the more skilled individuals. Consequently, the family net money income derived from off-farm employment by laborers and semi-skilled workers was considerably less than that of skilled workers.

**Stability of employment:** Stability of employment refers both to tenure in the particular job and to the steadiness of employment. Slightly more than half of the heads of off-farm work families had held only the one off-farm job at which they were then employed (Table 12). Tenure in the job among these family heads ranged from 1 to 35 years with the modal length of time being approximately 4 years. Only one in ten family heads in the off-farm work group had held four or more jobs. All of these heads were under 55 years of age and almost all were employed at common labor jobs. From an inspection of available data, there appears to be a very high degree of correlation between the educational level attained by the family head, type of employment, and tenure in the job.

In 1957-58, heads of off-farm-work group's families were employed from 100 to 312 days during the year, with the greatest number working 260 days. The more skilled or trained the worker the steadier his employment. For example, nearly all workers except those in operative, service, and laboring jobs in 1957-58 worked 40-hour weeks and were employed for the full year. Family heads employed at operative jobs were only slightly less steadily employed. Many common labor jobs, on the other hand, were seasonal, such as sawmill, construction and road work. That the greatest number of those working as common laborers were employed only 160 days during the year, indicates that underemployment of family heads in this group is pronounced. The study points up three disadvantages of common labor as an occupation: The rate of pay is usually substantially less than that for other occupations; the steadiness of and the possibiliy for tenure in the employment is less; and more travel is usually required to reach places of employment.

## NONWORK INCOME FAMILIES

Half of the families in the sample received their incomes principally from nonwork sources. Seventy-three of the 108 families (68 percent) in the nonwork income group received most of their income from transfer payments; that is, from welfare payments, old age pensions, and family support. The remaining 35 families (32 percent) received most of theirs from rental of agricultural land, mineral leases and royalties, military service benefits, and social security and other retirement payments.

### Families Dependent on Transfer Payments

The 73 rural nonfarm families depending primarily on transfer payments for their livelihood were classified into five groups according to their primary sources of income. These groups, the number in each group, and the average family net money income received were:

| Primary source of income | Number of families | Average family net money income from all sources |
|---|---|---|
| Welfare and old age payments | 40 | $ 566 |
| Social security payments | 15 | 1140 |
| Family contributions | 8 | 561 |
| Off-farm work | 6 | 1905 |
| Other nonwork income and savings | 4 | 65 |
| Total number and average income per family from all sources | 73 | 766 |

The groups are not mutually exclusive because some families, in particular the social security and off-farm-work groups, received income from more than one source. For example, only 24 families received all of their income from welfare or old age payments alone, while 23 other families received income from welfare or old age payments and one or more other sources. The average amount received from welfare and old age payments per family was $479. For six families, off-farm work was the greatest single source, yet for each of these income from that source amounted to less than half their total money income. All in all the 73 families in this class had 96 income sources.

**Specified family characteristics and levels of income:** Generally, as the age of the family heads increased, family net money incomes also increased (Table 13). Younger family heads generally had only a single source of income, such as welfare, whereas older household heads usually had two or more sources, such as welfare and financial contributions from children or rent from land. Only four welfare families had net money incomes of $2,000 or more and each of the four received income from two or more sources; primarily welfare payments and off-farm work.

Approximately the same proportion, one in seven, of white and nonwhite rural nonfarm families in the sample depended on transfer payments for their livelihood. The nonwhite families had slightly lower levels of income than did the white families. For example, all nonwhite families had net money incomes of less than $1,000 but only 75 percent of the white families received less than $1,000. Most white families but no nonwhite receiving over $1,000 net money income had more than one source of income.

More than a third (37 percent) of the families with income from transfer payments were headed by females. Families headed by women usually had lower incomes than did other families — for half of them, incomes were less than $500.

**Off-farm work income:** Families depending upon transfer payments for a livelihood received very little income from nonfarm employment. Where these families had off-farm employment, the work was usually seasonal in nature. Twelve of the 73 families dependent upon transfer payments received some income from off-farm work; eight of these families were headed by females. Most off-farm work was classified as common labor. Women worked primarily in garment factories and men at sawmills.

Total nonfarm work income was $10,-

**Table 13.—Specified characteristics of family heads by levels of family net money income, 73 rural nonfarm transfer payment dependent families, Clay-Hills Area of Mississippi, 1958.**

| Specified characteristics of family head | Levels of family net money income | | | | | |
|---|---|---|---|---|---|---|
| | Under $250 | $250-499 | $500-999 | $1000-1999 | $2000-2999 | Total |
| | | | —Number— | | | |
| Total, all family heads | 4 | 27 | 26 | 13 | 3 | 73 |
| Age | | | | | | |
| Under 55 years | 2 | 1 | -- | 2 | -- | 5 |
| 55-64 years | 1 | 5 | 2 | 3 | -- | 11 |
| 65 years and over | 1 | 21 | 24 | 8 | 3 | 57 |
| Years of school completed | | | | | | |
| None | 1 | 9 | 11 | 3 | -- | 24 |
| 1-4 years | -- | 4 | 3 | 2 | 2 | 11 |
| 5-7 years | 1 | 6 | 3 | 2 | -- | 12 |
| 8 years | -- | 7 | 5 | 4 | 1 | 17 |
| 9-12 years | 1 | 1 | 4 | 2 | -- | 8 |
| 13 years and over | 1 | -- | -- | -- | -- | 1 |
| Race | | | | | | |
| White | 3 | 22 | 22 | 13 | 3 | 63 |
| Nonwhite | 1 | 5 | 4 | -- | -- | 10 |
| Sex | | | | | | |
| Male | 3 | 14 | 18 | 10 | 2 | 47 |
| Female | 1 | 13 | 8 | 3 | 1 | 26 |

395, an average of $142 for all families dependent upon transfer payments. However, the average for only the 12 families doing nonfarm work was $866.

**Labor availability and utilization:** Rural nonfarm families dependent upon transfer payments had an average of two individuals per household 14 years of age or older. Most of the family members were 65 years of age or older. Therefore, these families generally had a relatively small labor supply available for work. Sixty percent of the families utilized less than 20 percent of their available labor, but 23 percent utilized 100 percent or more of their labor (Table 14). These extremes in labor utilization can be explained as follows: (1) Families utilizing their labor 100 percent or more were mostly households with only one adult member. Generally, households with more than one individual per household were made up of males and females 65 years of age or older. These were only allowed 0.5 and 0.0 "Productive man work units", respectively. Consequently, only a small amount of work in the garden or off-farm constituted a full work load for these families;[9] (2) Families utilizing less than 20 percent of their labor were mostly dependent on transfer payments for their livelihood and did not do off-farm work. Consequently, utilization of their labor was quite low.

## Families Dependent on Rentals and Retirement

Rentals, retirements, mineral leases, and royalties were the primary income sources of 35 of the rural nonfarm families. Families receiving income from these sources were slightly younger, had more years of formal schooling, and a considerably higher level of net family income than families in the welfare or transfer payment group.

The 35 families in the rental and retirement group received on the average $1,405 net money income. Primary source of income for these families was military service benefit payments, averaging $637 per family. These payments made up 45 percent of their total income. Off-farm work contributed $290 or 21 percent and rental income $244 or 17 percent, respectively, of their total income (Table 15).

**Specified family characteristics and levels of income:** Three-fifths of those families headed by individuals under 65 years of age but only one-third of those headed by individuals over 65 years of

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[9] See footnote 7.

Table 14.—Labor utilization and number in family 14 years of age and older, by levels of net family earnings, 73 rural nonfarm transfer payment dependent families, Clay-Hills Area of Mississippi, 1958.

| | Net family earnings | | | | | | |
|---|---|---|---|---|---|---|---|
| Item | Under $250 | $250-499 | $500-999 | $1000-1999 | $2000 2999 | $3000-over | Total |
| Total | 3 | 21 | 24 | 20 | 4 | 1 | 73 |
| Number in family 14 years of age and older | | | | | | | |
| 1 | 1 | 10 | 4 | 1 | -- | -- | 16 |
| 2 | 1 | 10 | 18 | 13 | 4 | -- | 46 |
| 3 | 1 | 1 | 1 | 6 | -- | 1 | 10 |
| 4 and over | | -- | 1 | -- | -- | -- | 1 |
| Labor utilization | | | | | | | |
| 100 percent and over | 1 | 7 | 8 | -- | 1 | -- | 17 |
| 80 to 99 percent | | | -- | -- | -- | -- | . |
| 60 to 79 percent | -- | -- | -- | -- | 1 | -- | 1 |
| 40 to 59 percent | 1 | -- | 1 | 2 | -- | 1 | 5 |
| 20 to 39 percent | | -- | 2 | 4 | -- | -- | 6 |
| Less than 20 percent | 1 | 14 | 13 | 14 | 2 | -- | 44 |

**Table 15.—Sources, amounts, and percentages of income received by 35 families depending primarily on rentals and retirements income for a livelihood, Clay-Hills Area of Mississippi, 1958.**

| Source of income | Average amount received:<br>Dollars | Percent |
|---|---|---|
| Nonwork income | | |
| Rental | 244 | 17 |
| Mineral leases and royalties | 16 | 1 |
| Military service benefits | 637 | 45 |
| Social security | 67 | 5 |
| Total nonwork income | 1115 | 79 |
| Total off-farm work | 290 | 21 |
| Total | 1405 | 100 |

**Table 16.—Specified characteristics of family heads by levels of family net money income, 35 rural nonfarm families depending upon rentals and retirement, Clay-Hills Area of Mississippi, 1958.**

| Specified characteristics of family heads | Family net money income<br>Under $250 | $250- to 499 | -500- to 999 | $1000- to 1999 | $2000- to 2999 | $3000 and over | Total |
|---|---|---|---|---|---|---|---|
| | | | | Number | | | |
| Total | 3 | 2 | 13 | 11 | 3 | 3 | 35 |
| Age | | | | | | | |
| Under 55 | 1 | -- | 3 | 4 | 1 | 1 | 10 |
| 55 to 64 | -- | 1 | 3 | 4 | -- | 2 | 10 |
| 65 years and over | 2 | 1 | 7 | 3 | 2 | -- | 15 |
| Education | | | | | | | |
| None | -- | -- | -- | 2 | -- | -- | 2 |
| 1 to 4 years | -- | -- | 5 | 2 | -- | 1 | 8 |
| 5 to 7 years | -- | 1 | 3 | 1 | 2 | -- | 7 |
| 8 years | 2 | -- | 3 | -- | 1 | -- | 6 |
| 9 to 12 years | 1 | -- | 2 | 6 | -- | 1 | 10 |
| 13 and over | -- | 1 | -- | -- | -- | 1 | 2 |
| Race | | | | | | | |
| White | 3 | 2 | 9 | 10 | 3 | 3 | 30 |
| Nonwhite | -- | -- | 4 | 1 | -- | -- | 5 |
| Sex | | | | | | | |
| Male | 2 | 1 | 7 | 9 | 2 | 2 | 23 |
| Female | 1 | 1 | 6 | 2 | 1 | 1 | 12 |

age had incomes over $1,000. The younger family heads were able to seek part-time employment, whereas the older heads were not.

The level of education of family heads in this group was only slightly associated with net family money income. A partial explanation for this nonassociation of education and income is that the major source of income was military service benefit payments. Another factor was the physical limitations of the family heads.

The average family net money income of the 30 white families was $1,417 compared to $974 for the 5 nonwhite families. Sixteen white families had incomes of more than $1,000, whereas only one nonwhites had a similar income (Table 6). Nonwhite families had only one source of income, but white families usually received income from two or more sources. Generally, as the number of sources of income increased, the net money income increased.

Two-thirds of the rural nonfarm families dependent upon rental and retirement income for a living had male household heads. These families usually received higher net money incomes than the families headed by females.

**Off-farm work income:** One in four of these families had off-farm employment income in addition to their rental and retirement income. Six of the household heads working off-farm worked as laborers in cotton mills, sawmills, and on farms. Eight of the nine off-farm jobs were seasonal in nature.

Off-farm-work income averaged $290 for all families dependent upon rental and retirement income for a living. The average per family doing nonfarm work (9 families) was $1,127.

## SUMMARY AND CONCLUSIONS

Among the rural nonfarm families studied, the heads of families with off-farm employment were younger and had more years of formal education than the average Clay-Hills family head. Many of these operators were young enough and had enough education to make some adustments possible. However, the majority of this group of families were already receiving net money incomes of $2,000 or more and, therefore, were not considered to be low income families.

However, some families within this off-farm work group did have an income problem. For instance, 6 percent of these families received net money incomes of less than $1,000, and another 22 percent had incomes between $1,000 and $2,000. However, about two out of three of these low income families would probably be unable to make adustments that would increase their net money incomes because of (1) the advanced age of the family head; (2) the low level of formal schooling attained by family members; or (3) the fact that the household lacked a male head (Table 17).

It is primarily the nonwork income groups among rural nonfarm families that are faced with a low income problem in absolute terms. Among families studied, those in this group that depended primarily upon transfer payments for a livelihood had the lowest average incomes. Only three of these families had net money incomes of $2,000 or more. If families having less than $2,000 net money are considered as low income families, 70 of the 73 families in this group had a low income problem. However, only two of the remaining 70 families had the nessary attributes to allow them to make appreciable adjustments that might increase their incomes. The other families had male heads who were handicapped by advanced age or by low levels of formal education, or had female heads.

The 35 nonwork income families that depended primarily upon rental and retirement incomes had only slightly higher incomes than those depending upon transfer payments. Six of the 35 families in this group had net money incomes of $2,000 or more. By definition, the remaining 29 families (83 percent) had a low income problem. However, only one in seven could make any major adjustments to increase net family money incomes. The remaining 86 percent had family heads who were either physically handicapped, or in the advanced age group, or poorly educated, or females.

In summary, of the families receiving less than $2,000 income, 13 percent of the off-farm employed families, 3 percent of the families dependent upon transfer payments, and 14 percent of the families dependent upon rental and retirement income, could probably make some adjustment that would increase their family incomes. In all, 59 percent of the rural nonfarm families in the survey had a low income problem (that is, a net money income of less than $2,000) but only one in seven of these families could make any major adjustments to increase their incomes.

What are some possible solutions or alternatives to the low income problem? The problem actually has two parts or

Table 17.—Adjustment potential of rural nonfarm family heads, Clay-Hills Area of Mississippi, 1958.

| Family classification | Total families in sample | Families receiving $2,000 or more net money income | Families receiving less than $2000 net money income | | |
|---|---|---|---|---|---|
| | | | Adjustment potential | | |
| | | | total | Yes | No |
| | | —Number— | | | |
| Off-farm work | 109 | 81 | 28 | 13 | 15 |
| Nonwork income | 108 | 9 | 99 | 6 | 93 |
| Welfare | 73 | 3 | 70 | 2 | 68 |
| Retired | 35 | 6 | 29 | 4 | 25 |
| All classes | 217 | 90 | 127 | 19 | 108 |

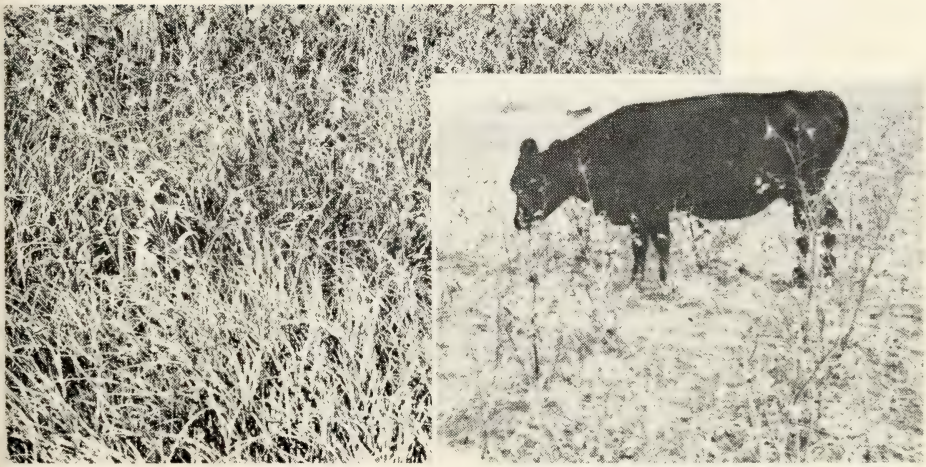
areas of attack. One area is the young families, the other is the families of advanced-age.

Young family heads who have the necessary education and adequate technical training in industrial trades may improve their position by equipping them to find new and better employment. This in all probability will mean that these families will have to emigrate because of the shortage of job opportunities in the area. Vocational technical training may be desirable for those individuals still in school who do not plan to go on to college, and for those who have finished their formal schooling but are still young enough to benefit by such training. This program, together with programs to develop industry in the area and provide incentives for emigration, appears to be of prime importance in alleviating the over abundance of unskilled labor and in increasing family incomes in most parts of the Clay-Hills Area. Many areas in the Clay-Hills are now involved in programs to bring in industry and in such cases adjustments are being made fairly rapidly.

Among the nonwork income families studied, most of the household heads were past the productive work age (65 years and over). Under these circumstances, the possibilities for any adjustments that will tend to increase earned family net money incomes are slight. These families primarily depend on welfare payments, family support, savings, social security, rents, and retirement for their livelihood. Therefore, any substantial increase in their incomes must come from State and Federal programs that increase the amount of their allotments, from extending medical care to the aged, and other programs. However, there may be opportunity to increase their level of living through better food production, care of health problems, and better management of income.

# The Economics of Pasture Yields in Beef Cattle Production

## Yazoo Mississippi Delta



Coastal Bermuda and crop residue important in Delta beef cattle production.

MISSISSIPPI STATE UNIVERSITY
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# THE ECONOMICS OF PASTURE YIELDS IN BEEF CATTLE PRODUCTION, YAZOO-MISSISSIPPI DELTA

By ARTHUR M. HEAGLER, GRADY B. CROWE and FRED T. COOKE, JR.[1]

Efficient use of pasture and forage crops is the key to a successful beef cattle operation in the Yazoo-Mississippi Delta. Selecting proper pasture crops and fitting them into a grazing system for efficient utilization has long been a problem of the beef cattle producer. Earlier studies in the Delta indicate that pasture establishment and maintenance costs account for 38 percent of all costs associated with cow-calf enterprises.

Results presented in this report are based on a comprehensive study made under actual farm conditions. This study was directed toward an economic evaluation of the various pasture crops associated with cow-calf enterprises in the Delta. Specifically, the objectives of the study were (1) to determine length of grazing periods and carrying capacities for major pasture crops, (2) to measure pasture production in beef yields for each pasture crop, and (3) to determine the relationship between pasture costs and beef yields for each pasture crop.

The part of the study with which this report is concerned was directed specifically toward an evaluation of individual pasture crops. No attempt is made at this time to fit the individual crops into grazing systems. However, in a later report alternative grazing systems and winter feeding programs will be evaluated.

The information presented here should be useful to farmers who are considering the establishment of a beef cattle enterprise or the expansion of an existing one. It should also be useful to those operators considering adjustments in their grazing programs. It must be remembered, however, that these results are based on average pasture and herd management and do not imply either minimum or maximum obtainable levels of production.

## Procedure

Data for the study were obtained from a selected group of commercial cow-calf producers. No purebred or show animal operations were included, nor was any other type of unusual production situation. Within these limitations, the farmers selected for study represented random samples of pasture management, herd management, and animal quality.

Late fall and winter calving programs are most common in the area, and were the only programs encountered in the study. The tests were conducted during the period 1955 to 1961. Data collected for each individual pasture included acreage, establishment and maintenance costs, and an estimate of botanical compositions.

Stocking rates, length of grazing periods, and beef yields were obtained by weighing a sample of cattle each time they were put on and taken off each pasture crop. All weighing was done by project personnel of the Farm Economics Division and the Delta Branch of the Mississippi Agricultural Experiment Station.

Botanical composition of each test pasture was determined by pasture specialists from the Delta Station. Botanical composition of the test pastures was generally a combination of two or more forage species. If a pasture contained 50 percent or more of one forage species it was considered to be a pasture of that species. For example, fescue-clover combinations are widely used in the area, with fescue occupying about two-thirds of a pasture and clover the remainder. These are referred to as fescue pastures. Pasture acreages were measured from county Agricultural Stabilization and Conservation Service maps.

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[1] Agricultural Economists, Farm Economics Division, Economic Research Service, U. S. Department of Agriculture, stationed at the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississiippi.

The study reported is part of a more comprehensive study of the economics of beef cattle production currently underway in the Yazoo-Mississippi Delta.

Data obtained on each pasture studied were summarized and averaged by pasture crop. A geometric rather than an arithmetic mean was used to evaluate the data for the following reasons: (1) geometric mean is the form of average best adapted when rates of change or ratios between measures are to be averaged, as equal weight is given to equal ratios of change; (2) the geometric mean gives less weight to extreme deviations in base data; and (3) the geometric mean is strictly determinate in averaging positive values.

The number of grazing tests made during the study was somewhat limited, as an intensive case study of this type necessarily limits the number of farm cooperators that can be readily handled.

Project personnel refrained from offering any advice concerning ways of improving pasture or herd management practices until the tests were completed.

## Beef Yields from Major Pasture Crops

Because of complexities involved in measuring pasture output it is necessary to consider a number of criteria. Length of grazing period, carrying capacity, and length of growing season all affect pasture utilization and beef yields, which are used in this study as the final measure of output. Especially are these items important in the development of grazing systems.

Beef yields, length of grazing period, stocking rates, and associated information for major pasture crops used in cow-calf enterprises are shown in table 1.

Length of grazing period measured in total days of grazing per year ranged from 27 days for crop residues to 208 days for Coastal Bermuda. For the permanent pasture crops included in the study, grazing periods ranged from 60 days for common Bermuda to 208 days for Coastal Bermuda. Stocking rates for the permanent pasture crops ranged from 0.5 animal unit per acre for Johnson grass to 1.3 animal units per acre for Coastal Bermuda.

The short grazing period (27 days) and high stocking rate (1.4 animal units per acre) associated with crop residues result from an intensive grazing program developed to utilize this forage as rapidly as possible.

Calf weight gains per acre ranged from 45 pounds on Johnson grass to 361 pounds on Coastal Bermuda. There was little difference in the gains obtained from common Bermuda and Dallis grass, from

Table 1.—Beef yields and associated information for cow-calf enterprises, Yazoo-Mississippi Delta.

| Pasture crop | Number of test pastures | Average acreage in test pastures | Total grazing per year | Animal units per acre | Calf weight gain per acre |
|---|---|---|---|---|---|
| | Number | Acres | Days | Number | Pounds |
| Summer pastures: | | | | | |
| Coastal Bermuda | 6 | 77 | 208 | 1.3 | 361 |
| Common Bermuda | 7 | 72 | 60 | 1.1 | 74 |
| Johnson grass | 10 | 79 | 72 | .5 | 45 |
| Dallis grass | 9 | 54 | 65 | 1.1 | 87 |
| Oats and ryegrass[1] | 5 | 65 | 100 | .6 | 105 |
| Winter pastures: | | | | | |
| Fescue | 13 | 71 | 135 | .8 | 98 |
| Crop residue | 12 | 58 | 27 | 1.4 | 54 |

[1] Major portion of grazing utilized in March, April, and May.

fescue, and from oats and ryegrass.

Because of the high establishment cost, only a small number of tests were encountered for temporary summer grazing crops such as sudan and millet, and these were not considered in the analysis. Data from these few tests, however, indicate that although forage production from such crops may be high, a problem of utilization results in relatively low yields of beef. Other summer grasses are cheaper and offer fewer problems in utilization.

In table 1, pasture crops are separated into two categories—winter and summer pastures. While these groupings are not hard and fast and may overlap somewhat, they are, in general, accurate descriptions. For reasons that will be discussed later, winter and summer pastures should not be compared directly in terms of beef yields.

The length of grazing period for each pasture studied was measured in total days of grazing provided during the season of productivity. During the course of the study it was recognized that grazing in two periods resulted in an increase in the total days of grazing obtained from several of the permanent pasture grasses. When separate grazing periods occurred in a pasture test, the periods were combined to reflect the total days of grazing obtained. Grazing periods for each pasture crop in table 1 are averages for all individual pastures of that type in the study.

Management practices used by cow-calf producers in the study shortened the length of grazing period and reduced pasture output of common Bermuda, Dallis, and Johnson grass. The breeding herd is usually winter fed on these pastures because they are generally grown on the higher and better drained soils devoted to the cow-calf enterprise. Pasture specialists reported that damage resulting from trampling or bogging during wet periods limited the potential carrying capacity and grazing period of all three grasses. Botanical composition of common Bermuda and Johnson grass pastures was sometimes drastically changed, and some Dallis grass stands disappeared entirely.

An accurate record was maintained of the composition and size of each test herd. The stocking rate was computed in animal unit increments (1,000 pounds of mature animal) per acre for each test pasture. Averages for each kind of pasture were computed. Only mature animal weights were used to determine stocking rates.

To compute pasture production or output, calf weight gains or losses were used. Weights were obtained from a marked sample of calves from the herds at the start and end of each grazing period on each pasture. Mature animal weight gains or losses were not included for the following reasons: (1) Mature animal weight gains and losses follow a cyclic pattern. Losses follow calving (November-January) and continue into early spring (February-March). Weight gains begin in April, continue into the fall, and end when calving begins. (2) Including these weight changes among mature animals in the computation had little, if any, effect on total pasture production for any grazing system. However, individual pasture crops within a grazing system were always affected—winter pastures adversely, and summer pastures favorably. (3) Experimental studies conducted in other cattle areas indicate that weight losses equal to 15 percent of total body weight by a mature brood cow due to calving and wintering do not affect calf rates of gain, weaning weights, or calf crop percentage.

The data presented in table 1 indicate, as might be expected, that long grazing periods and relatively high stocking rates result in the highest pasture yields. Coastal Bermuda is shown to be by far the most productive of the summer pastures even when compared with temporary grazing crops such as oats and ryegrass. Fescue is almost the only winter pasture used extensively. Reasons for considering crop residues as winter pasture will be discussed later.

Results from this study indicate that continuous grazing, when compared with split grazing periods, reduces total length of grazing period and calf weight gain per acre by 35 days and 23 pounds on fescue, 13 days and 9 pounds on Johnson grass, and 11 days and 45 pounds on Dallis grass. Although the other permanent and temporary grasses included in the study were grazed continuously, the possibility of increasing length of grazing period and calf weight gain per acre by splitting the grazing period should not be overlooked.

The relatively long fall and winter calving program usually found on Delta farms imposes a long grazing period on fall and winter pastures during which relatively low calf weight gains may be expected. Although this situation may exist in any breeding program, calf gains from fall and winter pastures could be increased by shortening the length of the calving program.

### Seasonal Productivity of Pastures

The seasonal productivity for the individual crops included in the study is shown in figure 1[2]. These grazing dates represent the period of adequate forage production rather than the length of grazing period. The seasonal productivity of fescue, as shown in figure 1, covers a 211-day period, whereas the length of grazing period under farm conditions covers approximately 135 days (table 1). Experimental results indicate fescue will provide grazing in either fall and spring, fall and winter, or winter and spring, depending on the farmer's need. Approximately 1½ acres of fescue would be required to provide grazing for one mature animal throughout its period of seasonal productivity when grazed in two periods and slightly over 2 acres when grazed continuously.

### The Use of Total Digestible Nutrients As a Measure of Pasture Productivity

The true value of certain grasses may be overlooked when calf weight gain per acre is used as the only measure of pas-

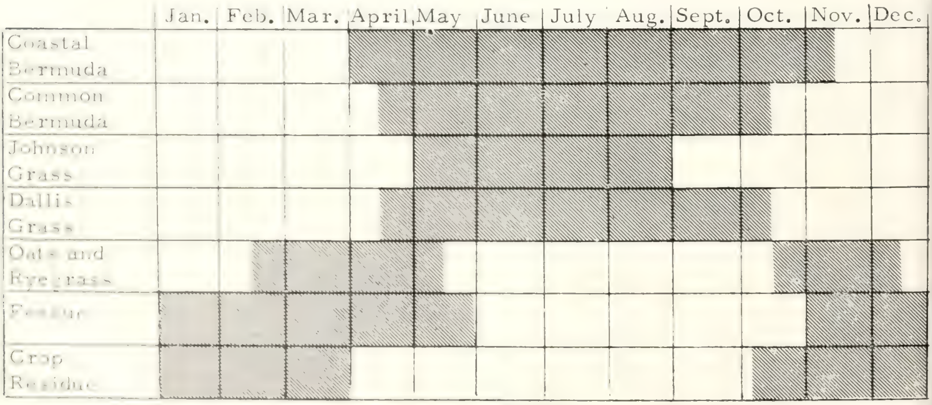

Figure 1. Seasonal productivity of major pasture crops, Yazoo-Mississippi Delta.

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[2] Dates of grazing periods based on experimental results obtained from pasture studies conducted at the Delta Branch Experiment Station and on outlying farms by Dr. P. G. Hogg, Assistant Superintendent and Agronomist.

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[3] "Methods of Computing Results from Grazing Trials," by H. L. Lucas, N. C. State University, and G. O. Mott, Purdue University. (Unpublished data).

ture output. The ability of a pasture to provide all or part of the nutrients required to maintain the body condition of the breeding herd and the additional nutrients required for any weight gains made by mature animals could not be evaluated under the conditions of this study.

Therefore, other methods of computing results of grazing trials based on the total digestible nutrient concept were reviewed. The method of measuring effective total digestible nutrient (ETDN) utilization per acre developed by Lucas and Mott[3] appears to be the best method presently available to compute and report grazing trial results when conducted in conjunction with cow-calf enterprises. This method employs the following: (1) The TDN required for maintenance of all animals, (2) the TDN required for weight gains of all animals, (3) the TDN requirements supplied by mature animals when weight losses occur, and (4) the TDN provided by supplemental feed when fed during a grazing period.

This method eliminates the need for a uniform group of test animals as it is based on the use of separate estimates of TDN required for the maintenance and weight gains of individual animals of different types, weight and condition. The results obtained also reflect the reaction of each animal to the pasture.

The ETDN utilized per acre, the proportion required for mantenance, and the proportion used for gain are presented in table 2 for each pasture crop included in the study.

Comparisons of ETDN utilization per acre should be limited to grasses producing forage in the same season. The data in table 2 indicate that higher levels of ETDN per acre are generally obtained from the summer grasses. This is the result of brood cow weight gains and continuous calf weight gains throughout the grazing period, and the fact that these pastures are not required to provide grazing for dry brood cows.

The effect of the fall and winter calving program on the level of ETDN utilization per acre obtained from all winter grasses cannot be overemphasized. These grasses provide grazing (a) following weaning of one calf crop and birth of another and (b) from calving through early lactation. Calf gain is low or nonexistent in the former situation and brood cow weight losses often exceed 100 pounds in the latter.

One of the inherent characteristics of any cow-calf program is the high percentage of ETDN necessary to maintain the breeding herd and the small percentage available for gains. Although large variations exist in the level of ETDN utilization per acre among both permanent and temporary pasture crops, there is little difference in the percentages of

**Table 2.—Effective total digestible nutrient utilization per acre, cow-calf enterprises, Yazoo-Mississippi Delta**

| Pasture crop | ETDN utilized per acre | Portion required for maintenance | Percentage of total | Portion used for gain | Percentage of total |
|---|---|---|---|---|---|
| | 100 units | 100 units | Percent | 100 units | Percent |
| Summer pastures: | | | | | |
| Coastal Bermuda | 35.1 | 26.4 | 75 | 8.7 | 25 |
| Common Bermuda | 10.6 | 8.1 | 76 | 2.5 | 24 |
| Johnson grass | 6.7 | 5.1 | 76 | 1.6 | 24 |
| Dallis grass | 11.4 | 9.0 | 79 | 2.4 | 21 |
| Oats and ryegrass | 8.0 | 6.0 | 75 | 2.0 | 25 |
| Winter pastures: | | | | | |
| Fescue | 10.7 | 8.2 | 77 | 2.5 | 23 |
| Crop residues | 6.1 | 5.2 | 85 | .9 | 15 |

this total required for maintenance and remaining for gain. Analysis of ETDN data indicates that from 75 to 85 percent of the ETDN utilized is needed to meet the maintenance requirement of the breeding herd (table 2).

The level of ETDN utilization per acre obtained from crop residues was limited by length of grazing period. Eighty-five percent of the ETDN was used to meet the maintenance requirement of the breeding herd. This high percentage reflects a minimum maintenance ration provided mature animals in conjunction with weight losses normally associated with calving and early lactation.

It should be noted that the ETDN per acre obtained from winter grasses will be greater and the percentage required for animal maintenance lower when Coastal Bermuda and/or crop residues are included in a grazing system. This permits late grazing of Coastal Bermuda and winter grazing of residues, both relatively cheap sources of forage, during the interval between calf crops, during calving and during early lactation, periods when ETDN requirements for maintenance are highest. As a result, winter grasses can be grazed in the early spring, a period when cow weight losses are low and calf weight gains are usually high.

### Costs-Output Relationships, Major Pasture Crops, Yazoo-Mississippi Delta

Calf gain and ETDN utilization per acre provide a sound basis for the agronomic evaluation of pasture crops. However, comparisons based on these measures alone may be misleading. Comparisons among pasture crops are more meaningful when pasture cost and pasture output are compared.

In table 3, pasture cost per hundredweight of calf grain provides a method of comparing pasture crops on the basis of this relationship. The pasture cost per hundredweight of calf gain for the permanent pasture crops included in the study ranged from a low of $3.21 for Coastal Bermuda to a high of $12.85 for Dallis grass. Costs for fescue, Johnson grass, and common Bermuda ranged from $9.00 to $11.50 per hundredweight of calf gain. Of all the pasture crops considered, crop residues were the cheapest and oats and ryegrass the most expensive.

Beef yields obtained per acre of oats and ryegrass exceeded those obtained

**Table 3.—Relationship between pasture costs and selected measures of pasture output, major pasture crops, cow-calf enterprises, Yazoo-Mississippi Delta.**

| Pasture crop | Annual establisment and maintenance cost per acre[1] | Calf weight gain per acre | Pasture cost per hundred-weight of calf gain | ETDN utilization per acre | Pasture coses per 100 units of ETDN utilization |
|---|---|---|---|---|---|
| | Dollars | Hundred-weight | Dollars | 100 units | Dollars |
| Summer pastures: | | | | | |
| Coastal Bermuda | 11.59 | 3.61 | 3.21 | 35.1 | .33 |
| Common Bermuda | 8.44 | .74 | 11.41 | 10.6 | .80 |
| Johnson grass | 4.10 | .45 | 9.11 | 6.7 | .61 |
| Dallis grass | 11.18 | .87 | 12.85 | 11.4 | .98 |
| Oats and ryegrass | 19.26 | 1.05 | 18.34 | 8.0 | 2.41 |
| Winter pastures: | | | | | |
| Fescue | 9.30 | .98 | 9.49 | 10.7 | .87 |
| Crop residues | 1.16 | .54 | 2.15 | 6.1 | .19 |

[1] Pasture establishment and maintenance costs obtained from The Economics of Beef Cattle Production in the Yazoo-Mississippi Delta," by Arthur M. Heagler, Fred T. Cooke, Jr., and Grady B. Crowe; Miss. Agr. Expt. Sta. Bul. 631, November 1961. Included in these costs are charges for labor, power, equipment and materials. No charges have been made for land rent or overhead costs.

from all other pasture crops except Coastal Bermuda. However, the high annual cost per acre of establishing this combination resulted in a relative high pasture cost per hundredweight of calf gain.

Calf weight gains per acre obtained from crop residue are low, but its use represents a salvage operation and annual establishment and maintenance costs are also low.

Also included in table 3 are pasture costs per 100 units of ETDN utilization. These costs, for permanent pastures, range from 33 cents on Coastal Bermuda to 98 cents for Dallis grass. They amount to 19 cents per 100 units for crop residues and $2.41 for oats and ryegrass.

The importance of the data in table 3 is readily noted when pasture comparisons based on pasture cost-pasture output relationship and pasture output measures are checked against each other. For example, oats and ryegrass produced slightly more calf gain and 270 units less ETDN per acre than fescue. However, pasture cost per hundredweight of calf gain for oats and ryegrass exceeds similar costs for fescue by roughly 100 percent. Pasture costs per 100 units of ETDN for oats and ryegrass were about three times those for fescue.

Although the relationship between pasture cost and pasture outputs provide a more precise method for pasture type comparisons the importance of carrying capacity, ETDN utilization per acre and grazing period length must also be considered. For example, pasture cost per hundredweight of calf gain for common Bermuda and Johnson grass are not greatly different. However, common Bermuda pastures had higher carrying capacities, and produced more units of ETDN per acre and more pounds of calf gain per acre with a grazing period 11 days shorter than Johnson grass.

## Summary

Results obtained from tests conducted on Delta plantations indicate that calf weight gains per acre range from a low of 0.45 hundredweight on Johnson grass to a high of 3.61 hundredweight on Coastal Bermuda. There was little difference in the level of calf weight gains per acre obtained from common Bermuda and Dallis grass. The practice of winter feeding the breeding herd on common Bermuda, Johnson grass and Dallis grass resulted in damage to the turf from excessive trampling and reduced the output potential of these pasture crops.

Although calf weight gains obtained from oats and ryegrass and fescue were almost identical, the seasons in which they were usually grazed were different. Generally fescue provided grazing in fall and winter and oats in late winter and spring.

The relatively low calf weight gains associated with crop residue grazing should not restrict its use as a partial substitute for either fescue or oats and ryegrass in any grazing system because it represents a cheap source of forage.

Evaluation of pasture output measured in ETDN (effective total digestive nutrient) utilization per acre indicates that although large variations existed in the level of ETDN utilization per acre among both permanent and temporary pasture crops there was little difference in the percentage of ETDN required for maintenance or used for gain. The low level of ETDN utilization per acre obtained from crop residue and the high percentage required for maintenance reflects the effect of a short grazing preiod in conjunction with the provision of a minimum maintenance ration and weight losses associated with calving.

Pasture cost per hundredweight of calf weight gain ranged from a low of $2.15 on crop residue to a high of $18.34 on oats and ryegrass. Coastal Bermuda cost was $3.21 and Johnson grass and fescue slightly more than $9.00 per hundredweight. These calculations facilitate the economic evaluation of pasture crops. However, carrying capacity, grazing period length, and ETDN utilization per acre of major importance when one pasture crop is being considered as a partial or complete substitute for another in a grazing system. Especially is this true when there is little or no difference in the pasture cost per hundredweight of calf gain between the two.

Sound judgment and experience are also necessary when making pasture adjustments. For example, theoretically crop residues may be used to replace the grazing furnished by fescue in the fall and winter and/or oats and ryegrass in the fall and spring. But, complete dependence on crop residues for grazing during the above mentioned periods would prove disastrous during periods of high rainfall or ground-covering snow. Cooperators who were using crop residue as a major source of fall, winter, and spring grazing indicated utilization was reduced by bogging during periods of high rainfall and a scarcity of forage when snow covered the ground and that a small amount of fescue or oats and ryegrass (1/8-1/4 acre per brood cow) should be maintained as an inclement weather safety factor.

BULLETIN 650 OCTOBER 1962

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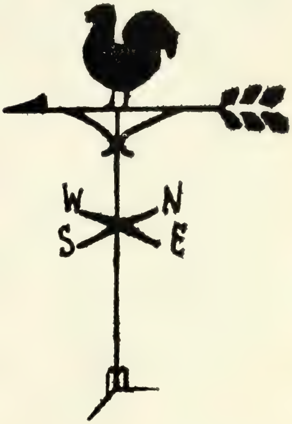
# Climatic Patterns Of Mississippi



By J. C. McWHORTER

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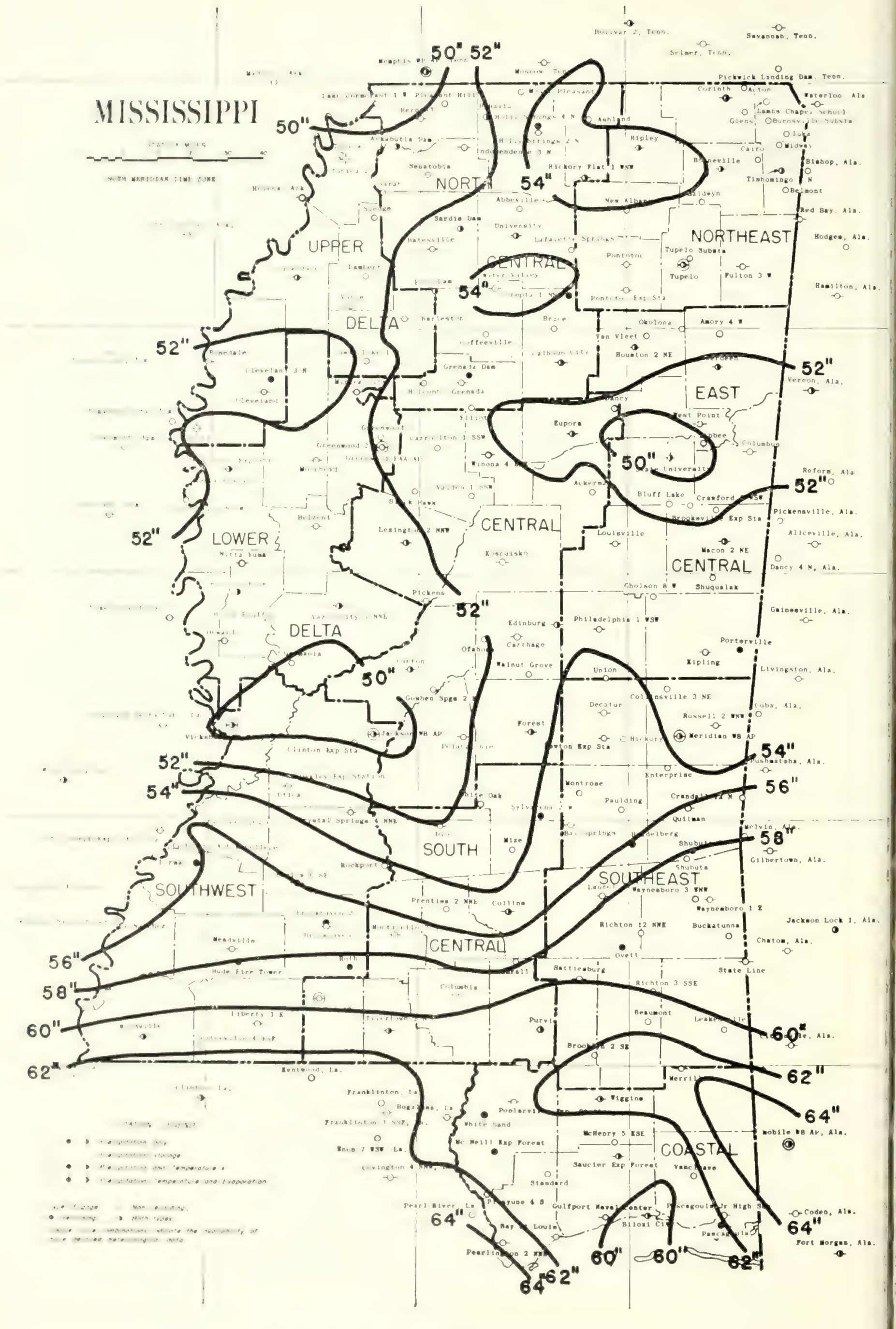
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New Albany
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State University
Starkville
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Bluff Lake
Crawford 6 WSW
Brooksville Exp Sta
Pickensville, Ala.
Aliceville, Ala.
Louisville
Macon 2 NE
Dancy 4 N, Ala.
Shuqualak
Gholson 8 W
Kosciusko
Lexington 2 NNW
Black Hawk
Belzoni
Vaiden 1 SSW
Moorhead
Pickens
Yazoo City 5 NNE
Edinburg
Philadelphia 1 WSW
Gainesville, Ala.
Carthage
Walnut Grove
Porterville
Kipling
Livingston, Ala.
Union
Decatur
Collinsville 3 NE
Russell 2 WNW
Meridian WB AP
Cuba, Ala.
Forest
Hickory
Newton Exp Sta
Pushmataha, Ala.
Enterprise
Montrose
Paulding
Quitman
Crandall 2 N
Sylvarena 2 W
Bay Springs
Heidelberg
Melvin, Ala.
Shubuta
Gilbertown, Ala.
Laurel
Waynesboro 3 WNW
Waynesboro 1 E
Buckatunna
Richton 12 NNE
Chatom, Ala.
Jackson Lock 1, Ala.
Ovett
State Line
Hattiesburg
Richton 3 SSE
Beaumont
Leakesville
Citronelle, Ala.
Purvis
Brooklyn 2 SE
Merrill
Wiggins
McHenry 5 ESE
Mobile WB AP, Ala.
Saucier Exp Forest
Vancleave
Standard
Gulfport Naval Center
Biloxi City
Pascagoula Jr High Sch
Pascagoula
Coden, Ala.
Fort Morgan, Ala.
Picayune 4 S
Bay St Louis
Pearlington 2 NNE
Pearl River, La.
Poplarville
White Sand
McNeill Exp Forest
Bogalusa, La.
Franklinton, La.
Franklinton 3 SSE, La.
Enon 7 WSW, La.
Covington 4 NNW, La.
Kentwood, La.
Clinton, La.
Liberty 1 E
Tylertown
Columbia
Hude Fire Tower
Ruth
Meadville
Monticello
Prentiss 2 NNE
Collins
Mize
Rockport
Crystal Springs 4 NNE
Utica
Raymond
Jackson WB AP
Clinton Exp Sta
Pelahatchie
Goshen Springs 2 N
Canton
Vicksburg
Rolling Fork
Onward
Natchez
Fayette
Mount Olive
Hazlehurst
Port Gibson
Harriston
Ofahoma
White Oak
Magee

Figure 1.—Mean annual precipation.

# CLIMATIC PATTERNS OF MISSISSIPPI

By J. C. McWHORTER

Moisture, temperature, soils, and vegetation are intimate factors influencing the cultural and economic development of society. In agriculture, certain areas are especially suited by both climate and soil to the crops they produce. If climate is not adequately considered, crops, soils, and man may fail. Today agriculture and industry must thoughtfully evaluate the influence of day-to-day weather and climatic characteristics in developing plans and operations.

Climate is the average condition of the weather at a place over a period of years as shown by temperature, precipitation, wind, sunshine, and other weather occurrences.

To arrive at this average condition for Mississippi, the United States Weather Bureau maintains a network of approximately 165 stations in the state which observe the daily weather. This daily observation is made by cooperative observers in accordance with certain standards. Reports are forwarded to the Bureau where the data is recorded.

For many years the Mississippi Agricultural Experiment Station has participated in this program by observing and reporting the weather at State College and at most of its Branch Stations.

The purpose of this report is to present data accumulated over a long period of years in such a manner that certain climatic characteristics of the state can be defined readily. Tables 1 to 3 include average temperature and precipitation values[1] from which portions of this report were developed.

Figure 1 was plotted by recording the mean annual precipitation at the location of its occurrence. Whole number values were then interpolated between the different stations. Lines denoting depth of precipitation were then plotted by connecting points of equal depth. Lines drawn through points of approximately equal value are known as isolines.

Similarly the other maps were constructed by isolines drawn through points of equal precipitation, equal temperatures, equal dates of occurrence (average dates of freezing temperatures) and equal numbers of tornadoes or winds of certain force.

A study of the graphical presentations in Figures 1 to 17 will enable one to characterize the climate for a specific location or the state as a whole.

Figures 1 to 9 show some of the precipitation patterns for the state. For example, Figure 1 reveals that the mean annual precipitation on the Gulf Coast at Pascagoula is 62 inches; while in north west Mississippi at Hernando the average is 50 inches. The other maps in this group enable one to make a rapid comparison of the precipitation between areas, seasons of the year, and extremes.

Temperature patterns for the warmest and coldest months are shown along with the mean annual temperature in Figures 10 to 12. The average date for the last spring and first fall day with temperatures of 32 degrees or lower are shown in Figures 13 and 14. It should be noted that the average date means that there is a 50 percent chance of the 32 degree day occurring before or after the average date.

The number of tornadoes, gale, and hurricane force winds are shown in Figures 15 to 17. To determine the frequency, the number of occurrences is divided into the period of years. For instance, in Figure 15, it is noted that four tornadoes have occurred in the Jackson area in 42 years. The frequency or recurrence interval would therefore be one tornado in ten years.

ACKNOWLEDGEMENT: Consulation and assistance were given by the Weather Bureau state climatologist at New Orleans, Louisiana, Ralph Sanders, retired.

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[1] Data furnished by Weather Bureau, U. S. Department of Commerce.

Table 1.—Mean precipitation 1931-1960.

| Station | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Ann. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Upper Delta Division** | | | | | | | | | | | | | |
| Clarksdale | 5.89 | 5.17 | 5.47 | 4.82 | 4.24 | 3.84 | 3.83 | 2.25 | 2.78 | 2.44 | 4.58 | 5.05 | 50.36 |
| Cleveland | 5.88 | 4.93 | 6.34 | 5.05 | 4.28 | 3.97 | 4.65 | 2.53 | 3.32 | 2.82 | 4.64 | 5.22 | 53.63 |
| Scott | 5.98 | 4.94 | 5.92 | 4.97 | 4.29 | 3.41 | 3.78 | 2.55 | 2.83 | 2.51 | 4.60 | 4.97 | 50.75 |
| Swan Lake | 5.77 | 4.91 | 5.89 | 4.83 | 3.87 | 4.03 | 4.54 | 2.75 | 3.03 | 2.46 | 4.73 | 5.03 | 51.84 |
| **North Central Division** | | | | | | | | | | | | | |
| Batesville | 6.05 | 4.92 | 5.85 | 5.21 | 3.97 | 3.57 | 4.05 | 3.32 | 3.14 | 2.65 | 4.57 | 5.30 | 52.60 |
| Grenada | 5.63 | 5.14 | 6.47 | 4.43 | 4.00 | 3.61 | 4.21 | 3.23 | 3.13 | 2.40 | 4.89 | 5.16 | 52.30 |
| Holly Springs | 6.43 | 5.48 | 5.71 | 4.79 | 4.26 | 3.72 | 4.60 | 3.19 | 3.79 | 2.91 | 4.68 | 5.03 | 54.59 |
| University | 5.97 | 5.29 | 5.76 | 5.05 | 4.02 | 3.88 | 4.04 | 2.91 | 3.53 | 2.83 | 4.84 | 5.09 | 53.21 |
| Water Valley | 5.64 | 5.14 | 6.23 | 5.20 | 3.92 | 3.86 | 4.57 | 3.09 | 3.57 | 2.69 | 4.60 | 5.25 | 53.76 |
| **Northeast Division** | | | | | | | | | | | | | |
| Booneville | 6.04 | 5.70 | 5.90 | 4.87 | 4.12 | 3.70 | 4.06 | 3.22 | 3.25 | 2.99 | 4.68 | 5.42 | 53.95 |
| Corinth | 6.23 | 5.38 | 5.35 | 4.72 | 4.02 | 3.77 | 3.95 | 3.40 | 3.16 | 2.77 | 4.56 | 4.84 | 52.15 |
| Fulton | 5.48 | 5.78 | 6.40 | 4.88 | 4.11 | 3.60 | 4.75 | 3.16 | 3.18 | 2.48 | 4.38 | 5.05 | 53.25 |
| Pontotoc | 5.66 | 5.17 | 6.23 | 5.06 | 3.70 | 4.05 | 4.87 | 3.28 | 3.43 | 2.45 | 4.57 | 5.16 | 53.63 |
| Tupelo | 5.85 | 5.49 | 6.64 | 4.36 | 3.97 | 3.89 | 4.30 | 2.57 | 3.17 | 2.87 | 4.39 | 5.33 | 52.63 |
| **Lower Delta Division** | | | | | | | | | | | | | |
| Belzoni | 5.55 | 5.12 | 5.53 | 5.09 | 3.66 | 3.77 | 3.78 | 2.75 | 2.61 | 2.53 | 4.69 | 5.31 | 50.39 |
| Greenville | 6.43 | 5.22 | 5.70 | 5.41 | 4.03 | 3.24 | 4.42 | 2.62 | 3.21 | 2.38 | 4.64 | 5.25 | 52.55 |
| Greenwood | 5.62 | 5.04 | 5.70 | 4.81 | 4.06 | 3.75 | 4.45 | 3.06 | 3.12 | 2.39 | 4.70 | 5.41 | 52.11 |
| Moorhead | 5.48 | 4.77 | 5.76 | 5.16 | 3.59 | 3.81 | 4.58 | 2.81 | 3.10 | 2.44 | 4.53 | 4.85 | 50.88 |
| Stoneville | 5.59 | 4.98 | 5.56 | 4.96 | 4.21 | 3.87 | 4.03 | 2.55 | 2.99 | 2.61 | 4.23 | 5.28 | 50.86 |
| Yazoo City | 5.06 | 5.19 | 5.49 | 4.83 | 3.97 | 3.99 | 4.29 | 2.98 | 2.36 | 2.51 | 4.47 | 5.10 | 50.24 |
| **Central Division** | | | | | | | | | | | | | |
| Canton | 5.21 | 4.95 | 5.75 | 4.73 | 4.26 | 3.52 | 4.78 | 3.40 | 2.29 | 2.03 | 4.02 | 5.37 | 50.31 |
| Edinburg | 5.45 | 5.57 | 6.12 | 5.00 | 4.34 | 3.86 | 5.50 | 3.36 | 2.80 | 2.26 | 3.89 | 5.30 | 53.45 |
| Eupora | 5.72 | 5.10 | 5.88 | 4.44 | 3.67 | 4.06 | 4.90 | 3.35 | 2.77 | 2.53 | 3.96 | 4.98 | 51.36 |
| Kosciusko | 5.54 | 5.52 | 5.82 | 4.96 | 4.08 | 3.72 | 5.36 | 3.21 | 2.98 | 2.43 | 4.33 | 5.12 | 53.07 |

| Station | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Ann. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **East Central Division** | | | | | | | | | | | | | |
| Aberdeen | 5.57 | 5.53 | 6.01 | 4.70 | 3.71 | 4.02 | 4.88 | 3.08 | 2.89 | 2.60 | 3.97 | 4.88 | 51.84 |
| Columbus | 5.74 | 5.44 | 5.68 | 4.19 | 3.38 | 3.51 | 5.12 | 2.99 | 3.37 | 2.77 | 3.81 | 4.72 | 50.72 |
| Louisville | 5.73 | 5.88 | 6.10 | 4.55 | 4.11 | 3.61 | 6.08 | 3.36 | 3.19 | 2.41 | 4.00 | 4.92 | 53.94 |
| Macon | 5.50 | 5.92 | 6.01 | 4.90 | 3.86 | 3.13 | 5.49 | 3.31 | 3.19 | 2.74 | 4.10 | 4.91 | 53.06 |
| State University | 5.34 | 5.09 | 5.65 | 4.00 | 3.51 | 3.31 | 5.15 | 3.13 | 2.67 | 2.59 | 3.72 | 4.77 | 48.93 |
| **Southwest Division** | | | | | | | | | | | | | |
| Brookhaven | 5.31 | 5.21 | 6.22 | 5.44 | 4.89 | 4.58 | 5.71 | 3.74 | 3.58 | 2.47 | 4.10 | 5.78 | 57.03 |
| Jackson | 4.94 | 4.88 | 5.57 | 4.51 | 4.16 | 3.85 | 4.64 | 3.34 | 2.48 | 1.94 | 3.70 | 5.32 | 49.33 |
| Natchez | 5.52 | 4.94 | 6.24 | 5.08 | 5.98 | 4.03 | 4.18 | 3.86 | 2.83 | 2.21 | 4.46 | 5.64 | 54.97 |
| Port Gibson | 5.60 | 5.47 | 6.09 | 5.67 | 4.95 | 4.44 | 4.88 | 3.87 | 2.86 | 2.41 | 4.47 | 5.41 | 56.12 |
| Utica | 5.39 | 5.05 | 5.90 | 5.50 | 4.71 | 4.00 | 4.85 | 3.24 | 2.81 | 2.16 | 3.98 | 5.21 | 52.80 |
| Vicksburg | 5.13 | 5.31 | 5.73 | 4.92 | 4.13 | 3.46 | 3.90 | 3.01 | 2.50 | 2.04 | 4.43 | 4.94 | 49.50 |
| **South Central Division** | | | | | | | | | | | | | |
| Collins | 4.89 | 4.95 | 5.82 | 5.06 | 4.72 | 4.07 | 6.12 | 4.00 | 3.79 | 2.50 | 3.52 | 5.10 | 54.54 |
| Columbia | 5.04 | 5.32 | 6.34 | 5.67 | 4.90 | 4.93 | 6.17 | 4.37 | 4.34 | 2.92 | 3.99 | 5.78 | 59.77 |
| Monticello | 5.50 | 5.29 | 6.33 | 5.54 | 4.97 | 4.04 | 5.84 | 3.84 | 3.47 | 2.58 | 3.67 | 5.56 | 56.63 |
| **Southeast Division** | | | | | | | | | | | | | |
| Enterprise | 5.07 | 5.16 | 6.34 | 5.32 | 4.04 | 4.08 | 6.48 | 3.30 | 3.78 | 2.06 | 3.59 | 5.10 | 54.32 |
| Hattiesburg | 4.74 | 5.32 | 6.73 | 5.52 | 5.16 | 4.16 | 6.79 | 5.12 | 4.21 | 2.70 | 4.05 | 5.68 | 60.18 |
| Hickory | 5.41 | 5.19 | 6.50 | 5.62 | 4.02 | 3.52 | 6.24 | 3.69 | 3.58 | 2.47 | 3.93 | 5.66 | 55.83 |
| Laurel | 5.08 | 5.37 | 6.78 | 5.70 | 4.49 | 4.12 | 6.77 | 4.09 | 3.95 | 2.59 | 3.79 | 5.18 | 57.91 |
| Leakesville | 4.69 | 4.48 | 6.68 | 5.57 | 4.70 | 4.72 | 7.41 | 4.89 | 4.65 | 2.56 | 4.32 | 5.53 | 60.20 |
| Meridian | 4.69 | 5.09 | 6.32 | 5.33 | 3.91 | 4.07 | 6.22 | 3.54 | 3.33 | 2.22 | 3.10 | 5.31 | 53.13 |
| Shubuta | 4.92 | 5.36 | 6.93 | 5.44 | 4.49 | 4.25 | 7.77 | 3.47 | 4.14 | 2.21 | 3.86 | 5.59 | 58.43 |
| Waynesboro | 4.61 | 5.18 | 7.00 | 5.64 | 4.13 | 4.17 | 6.70 | 4.53 | 4.14 | 2.38 | 4.01 | 5.66 | 58.15 |
| **Coastal Division** | | | | | | | | | | | | | |
| Bay Saint Louis | 4.33 | 4.57 | 5.95 | 5.79 | 4.63 | 4.73 | 7.86 | 5.96 | 6.24 | 2.68 | 3.43 | 5.25 | 61.42 |
| Biloxi City | 3.85 | 4.00 | 6.10 | 4.75 | 4.71 | 5.09 | 7.33 | 5.71 | 6.50 | 2.52 | 3.29 | 4.73 | 58.58 |
| Merrill | 4.54 | 4.43 | 6.64 | 5.75 | 5.05 | 5.15 | 8.32 | 5.66 | 5.62 | 2.69 | 4.23 | 5.52 | 63.60 |
| Pearlington | 4.50 | 5.20 | 6.32 | 5.63 | 4.52 | 5.28 | 8.64 | 6.72 | 6.00 | 2.62 | 3.82 | 5.14 | 64.39 |
| Poplarville | 4.63 | 5.04 | 6.58 | 5.24 | 5.07 | 5.04 | 7.05 | 5.70 | 4.99 | 2.49 | 4.29 | 5.69 | 61.81 |

Table 2.—Mean Temperatures 1931-1960.

| Station | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Ann. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Upper Delta Division** | | | | | | | | | | | | | |
| Clarksdale | 45.2 | 48.1 | 55.1 | 65.0 | 73.4 | 81.1 | 83.4 | 83.0 | 76.9 | 66.5 | 53.7 | 46.5 | 64.8 |
| Scott | 44.2 | 47.1 | 53.8 | 63.4 | 71.8 | 79.3 | 81.6 | 81.1 | 75.1 | 62.8 | 52.5 | 45.6 | 63.2 |
| **North Central Division** | | | | | | | | | | | | | |
| Batesville | 43.8 | 46.6 | 53.2 | 62.9 | 70.9 | 78.5 | 81.2 | 80.7 | 74.5 | 63.7 | 51.8 | 45.0 | 62.7 |
| Holly Springs | 42.7 | 45.1 | 52.0 | 61.9 | 69.9 | 77.8 | 80.7 | 80.2 | 73.9 | 63.6 | 51.3 | 44.1 | 61.9 |
| University | 44.2 | 46.9 | 53.7 | 63.3 | 70.9 | 78.6 | 81.0 | 81.0 | 75.0 | 64.7 | 52.3 | 45.6 | 63.1 |
| Water Valley | 44.8 | 47.5 | 53.7 | 62.9 | 70.4 | 78.2 | 81.1 | 80.7 | 74.7 | 64.4 | 52.8 | 46.0 | 63.1 |
| **Northeast Division** | | | | | | | | | | | | | |
| Booneville | 42.4 | 44.5 | 51.4 | 61.2 | 69.6 | 77.4 | 80.2 | 79.9 | 73.9 | 63.4 | 50.8 | 43.6 | 61.5 |
| Corinth | 43.2 | 45.6 | 52.5 | 62.6 | 71.0 | 78.9 | 81.7 | 81.2 | 74.9 | 64.1 | 51.5 | 44.6 | 62.7 |
| Pontotoc | 44.5 | 47.0 | 53.7 | 63.0 | 70.8 | 78.4 | 80.8 | 80.6 | 74.8 | 64.7 | 52.4 | 45.6 | 63.0 |
| Tupelo | 44.1 | 46.6 | 53.2 | 62.9 | 71.5 | 79.5 | 81.9 | 81.6 | 75.2 | 64.3 | 51.8 | 45.3 | 63.2 |
| **Lower Delta Division** | | | | | | | | | | | | | |
| Belzoni | 46.9 | 49.9 | 56.4 | 65.1 | 73.1 | 80.2 | 82.4 | 82.0 | 76.1 | 66.0 | 54.1 | 48.1 | 65.0 |
| Greenville | 46.2 | 48.9 | 55.5 | 64.5 | 72.6 | 79.9 | 82.3 | 82.0 | 76.2 | 66.4 | 54.1 | 47.3 | 64.7 |
| Greenwood | 46.4 | 49.2 | 55.7 | 64.7 | 72.9 | 80.2 | 82.5 | 82.1 | 76.0 | 65.5 | 53.4 | 47.3 | 64.7 |
| Moorhead | 46.1 | 48.9 | 55.4 | 64.5 | 72.6 | 80.0 | 82.3 | 81.3 | 75.6 | 64.9 | 53.3 | 47.3 | 64.4 |
| Stoneville | 46.1 | 48.7 | 55.1 | 64.0 | 71.9 | 79.3 | 81.7 | 81.2 | 75.5 | 65.2 | 53.5 | 47.2 | 64.1 |
| Yazoo City | 47.6 | 50.3 | 56.7 | 65.3 | 73.0 | 80.0 | 82.3 | 82.0 | 76.7 | 66.5 | 54.6 | 48.7 | 65.2 |
| **Central Division** | | | | | | | | | | | | | |
| Canton | 48.3 | 50.7 | 56.5 | 64.5 | 72.2 | 79.2 | 81.5 | 81.2 | 76.0 | 66.0 | 54.7 | 49.3 | 65.0 |
| Edinburg | 47.6 | 49.9 | 55.6 | 63.6 | 70.9 | 78.1 | 80.4 | 79.9 | 74.8 | 64.6 | 53.5 | 48.1 | 63.9 |
| Eupora | 46.1 | 48.5 | 54.5 | 63.1 | 70.8 | 78.3 | 80.7 | 80.2 | 74.7 | 64.7 | 53.0 | 46.7 | 63.4 |
| Kosciusko | 46.3 | 48.7 | 55.1 | 63.5 | 71.4 | 78.6 | 80.9 | 80.7 | 75.2 | 65.3 | 53.5 | 47.3 | 63.9 |

| Station | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Ann. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **East Central Division** | | | | | | | | | | | | | |
| Aberdeen | 46.2 | 48.6 | 55.0 | 63.7 | 71.7 | 79.3 | 81.7 | 81.5 | 75.4 | 64.9 | 53.1 | 46.9 | 64.0 |
| Columbus | 46.9 | 49.1 | 55.5 | 64.0 | 71.9 | 79.6 | 81.7 | 81.6 | 76.0 | 65.5 | 53.6 | 47.5 | 64.4 |
| Louisville | 46.5 | 48.8 | 55.1 | 63.5 | 71.4 | 78.8 | 81.0 | 80.9 | 75.1 | 65.1 | 53.4 | 47.1 | 63.9 |
| Macon | 47.0 | 49.5 | 56.0 | 64.6 | 72.6 | 80.1 | 82.3 | 82.0 | 76.6 | 66.3 | 54.3 | 47.6 | 64.9 |
| State University | 46.9 | 49.3 | 55.5 | 64.2 | 72.0 | 79.3 | 81.4 | 81.1 | 75.9 | 65.7 | 54.1 | 47.7 | 64.4 |
| **Southwest Division** | | | | | | | | | | | | | |
| Brookhaven | 50.7 | 53.0 | 58.4 | 65.7 | 73.2 | 79.8 | 81.5 | 81.4 | 76.9 | 67.9 | 56.9 | 51.4 | 66.4 |
| Jackson | 48.0 | 50.7 | 56.4 | 64.4 | 72.5 | 79.4 | 81.6 | 81.3 | 76.2 | 66.5 | 54.9 | 49.0 | 65.1 |
| Natchez | 51.0 | 53.8 | 59.0 | 66.5 | 73.5 | 80.1 | 82.0 | 81.9 | 77.3 | 68.0 | 57.2 | 52.2 | 66.9 |
| Port Gibson | 48.5 | 51.5 | 57.3 | 64.7 | 72.1 | 78.7 | 81.0 | 80.6 | 75.4 | 65.5 | 54.4 | 49.2 | 64.9 |
| Utica | 50.0 | 52.6 | 58.0 | 65.6 | 73.1 | 80.0 | 82.1 | 81.9 | 77.2 | 67.6 | 56.5 | 51.0 | 66.3 |
| Vicksburg | 49.0 | 51.8 | 57.6 | 65.7 | 73.4 | 79.7 | 81.8 | 81.7 | 76.6 | 67.5 | 56.2 | 50.3 | 65.9 |
| **South Central Division** | | | | | | | | | | | | | |
| Columbia | 52.2 | 54.7 | 59.9 | 67.2 | 74.4 | 81.0 | 82.4 | 82.0 | 77.4 | 67.9 | 57.5 | 52.7 | 67.4 |
| Monticello | 50.8 | 53.1 | 58.3 | 65.6 | 72.9 | 79.6 | 81.8 | 81.2 | 76.6 | 67.0 | 56.2 | 51.2 | 66.2 |
| **Southeast Division** | | | | | | | | | | | | | |
| Hattiesburg | 51.6 | 54.0 | 59.1 | 66.3 | 73.8 | 80.2 | 81.7 | 81.3 | 76.7 | 67.0 | 56.7 | 51.7 | 66.7 |
| Laurel | 50.1 | 52.2 | 58.0 | 65.6 | 73.3 | 80.1 | 81.7 | 81.6 | 76.8 | 67.4 | 56.2 | 50.3 | 66.1 |
| Meridian | 48.1 | 50.6 | 56.5 | 64.4 | 72.4 | 79.5 | 81.5 | 81.2 | 75.9 | 65.6 | 54.1 | 48.3 | 64.9 |
| Waynesboro | 50.2 | 52.7 | 57.9 | 65.3 | 72.6 | 79.3 | 80.8 | 80.6 | 76.0 | 66.4 | 55.6 | 50.4 | 65.7 |
| **Coastal Division** | | | | | | | | | | | | | |
| Bay Saint Louis | 53.2 | 55.6 | 60.4 | 67.9 | 75.3 | 80.9 | 82.1 | 82.1 | 78.6 | 69.9 | 59.3 | 53.8 | 68.3 |
| Biloxi City | 53.6 | 55.4 | 60.1 | 67.3 | 74.8 | 80.6 | 81.9 | 81.9 | 78.1 | 69.9 | 59.6 | 54.4 | 68.1 |
| Poplarville | 53.5 | 55.7 | 60.2 | 67.0 | 74.3 | 80.3 | 81.6 | 81.4 | 77.6 | 69.5 | 59.3 | 54.3 | 67.9 |

## Table 3—Mean Precipitation 1931-60

| Station | Winter | Spring | Summer | Fall | Growing Season | Annual |
|---|---|---|---|---|---|---|
| **Upper Delta Division** | | | | | | |
| Clarksdale | 16.11 | 14.53 | 9.92 | 9.80 | 24.45 | 50.36 |
| Cleveland | 16.03 | 15.67 | 11.15 | 10.78 | 26.82 | 53.63 |
| Scott | 15.89 | 15.18 | 9.74 | 9.94 | 24.92 | 50.75 |
| Swan Lake | 15.71 | 14.59 | 11.32 | 10.22 | 25.91 | 51.84 |
| **North Central Division** | | | | | | |
| Batesville | 16.27 | 15.03 | 10.94 | 10.36 | 25.97 | 52.60 |
| Grenada | 15.93 | 14.90 | 11.05 | 10.42 | 25.95 | 52.30 |
| Holly Springs | 16.94 | 14.76 | 11.51 | 11.38 | 26.27 | 54.59 |
| University | 16.35 | 14.83 | 10.83 | 11.20 | 25.66 | 53.21 |
| Water Valley | 16.03 | 15.35 | 11.52 | 10.86 | 26.87 | 53.76 |
| **Northeast Division** | | | | | | |
| Booneville | 17.16 | 14.89 | 10.98 | 10.92 | 25.87 | 53.95 |
| Corinth | 16.45 | 14.09 | 11.12 | 10.49 | 25.21 | 52.15 |
| Fulton | 16.31 | 15.39 | 11.51 | 10.04 | 26.90 | 53.25 |
| Pontotoc | 15.99 | 14.99 | 12.20 | 10.45 | 27.19 | 53.63 |
| Tupelo | 16.67 | 14.97 | 10.56 | 10.43 | 25.53 | 52.63 |
| **Lower Delta Division** | | | | | | |
| Belzoni | 15.98 | 14.28 | 10.30 | 9.83 | 24.58 | 50.39 |
| Greenville | 16.90 | 15.14 | 10.28 | 10.23 | 25.42 | 52.55 |
| Greenwood | 16.07 | 14.57 | 11.26 | 10.21 | 25.83 | 52.11 |
| Moorhead | 15.10 | 14.51 | 11.20 | 10.07 | 25.71 | 50.88 |
| Stoneville | 15.85 | 14.73 | 10.45 | 9.83 | 25.18 | 50.86 |
| Yazoo City | 15.35 | 14.29 | 11.26 | 9.34 | 25.55 | 50.24 |
| **Central Division** | | | | | | |
| Canton | 15.53 | 14.74 | 11.70 | 8.34 | 26.44 | 50.31 |
| Edinburg | 16.32 | 15.46 | 12.72 | 8.95 | 28.18 | 53.45 |
| Eupora | 15.80 | 13.99 | 12.31 | 9.26 | 26.30 | 51.36 |
| Kosciusko | 16.18 | 14.86 | 12.29 | 9.74 | 27.15 | 53.07 |
| **East Central Division** | | | | | | |
| Aberdeen | 15.98 | 14.42 | 11.98 | 9.46 | 26.40 | 51.84 |
| Columbus | 15.90 | 13.25 | 11.62 | 9.95 | 24.87 | 50.72 |
| Louisville | 16.53 | 14.76 | 13.05 | 9.60 | 27.81 | 53.94 |
| Macon | 16.33 | 14.77 | 11.93 | 10.03 | 26.70 | 53.06 |
| State University | 15.20 | 13.16 | 11.59 | 8.98 | 24.75 | 48.93 |
| **Southwest Division** | | | | | | |
| Brookhaven | 16.30 | 16.55 | 14.03 | 10.15 | 30.58 | 57.03 |
| Jackson | 15.14 | 14.24 | 11.83 | 8.12 | 26.07 | 49.33 |
| Natchez | 16.10 | 17.30 | 12.07 | 9.50 | 29.37 | 54.97 |
| Port Gibson | 16.48 | 16.71 | 13.19 | 9.74 | 29.90 | 56.12 |
| Utica | 15.65 | 16.11 | 12.09 | 8.95 | 28.20 | 52.80 |
| Vicksburg | 15.38 | 14.78 | 10.37 | 8.97 | 25.15 | 49.50 |
| **South Central Division** | | | | | | |
| Collins | 14.94 | 15.60 | 14.19 | 9.81 | 29.79 | 54.54 |
| Columbia | 16.14 | 16.91 | 15.47 | 11.25 | 32.38 | 59.77 |
| Monticello | 16.35 | 16.84 | 13.72 | 9.72 | 30.56 | 56.63 |
| **Southeast Division** | | | | | | |
| Enterprise | 15.33 | 15.70 | 13.86 | 9.43 | 29.56 | 54.32 |
| Hattiesburg | 15.74 | 17.41 | 16.07 | 10.96 | 33.48 | 60.18 |
| Hickory | 16.26 | 16.14 | 13.45 | 9.98 | 29.59 | 55.83 |
| Laurel | 15.63 | 16.97 | 14.98 | 10.33 | 31.95 | 57.91 |
| Leakesville | 14.70 | 16.95 | 17.02 | 11.53 | 33.97 | 60.20 |
| Meridian | 15.09 | 15.56 | 13.83 | 8.65 | 29.39 | 53.13 |
| Shubuta | 15.87 | 16.86 | 15.49 | 10.21 | 32.35 | 58.43 |
| Waynesboro | 15.45 | 16.77 | 15.40 | 10.53 | 32.17 | 58.15 |
| **Coastal Division** | | | | | | |
| Bay Saint Louis | 14.15 | 16.37 | 18.55 | 12.35 | 34.92 | 61.42 |
| Biloxi City | 12.58 | 15.56 | 18.13 | 12.31 | 33.69 | 58.58 |
| Merrill | 14.49 | 17.44 | 19.13 | 12.54 | 36.57 | 63.60 |
| Pearlington | 14.84 | 16.47 | 20.64 | 12.44 | 37.11 | 64.39 |
| Poplarville | 15.36 | 16.89 | 17.79 | 11.77 | 34.68 | 61.81 |

Winter — Dec., Jan., Feb.
Spring — Mar., Apr., May
Summer — June, July, Aug.
Fall — Sept., Oct., Nov.
Growing Season — Spring and Summer

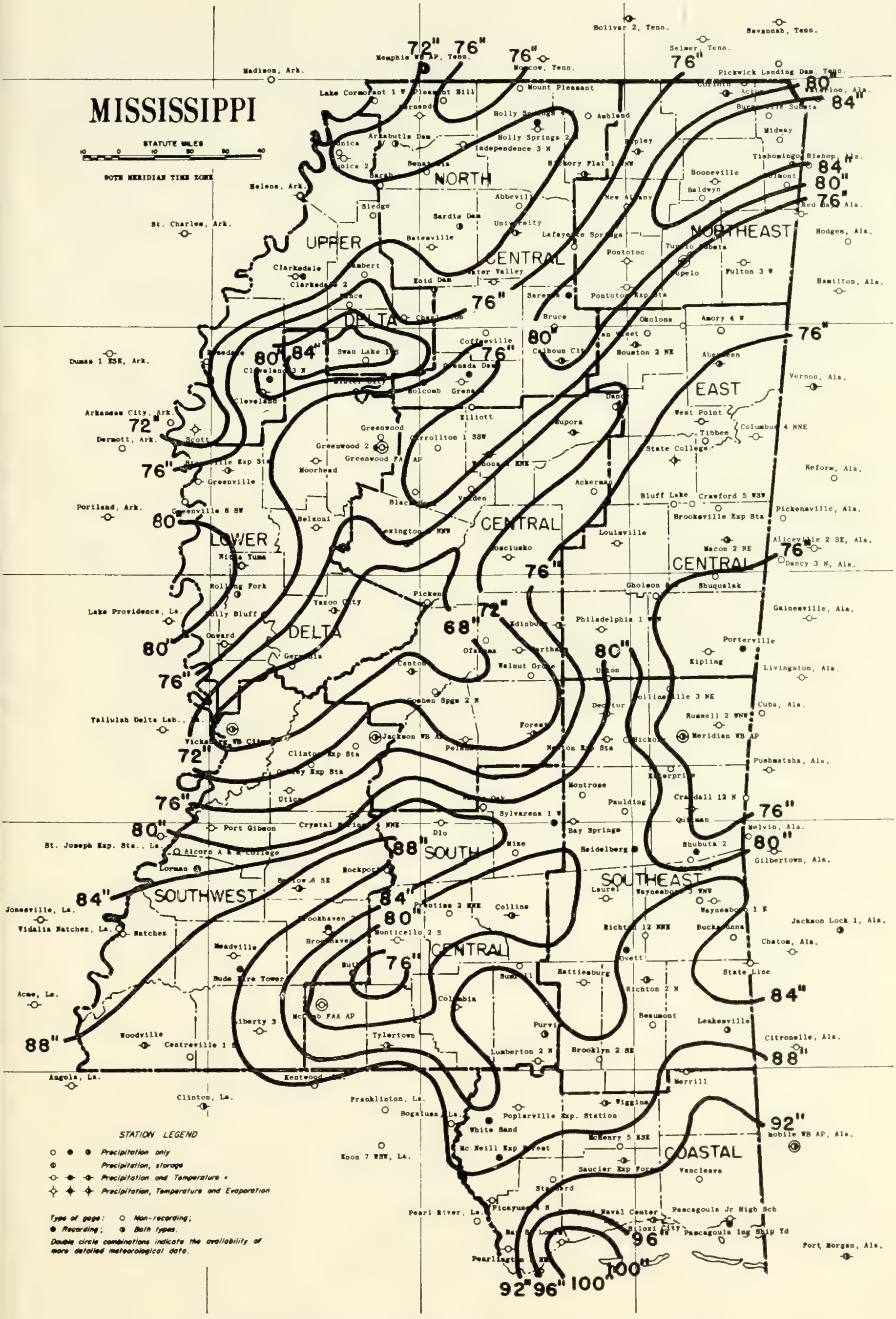

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER
DELTA
LOWER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
SOUTH
CENTRAL
SOUTHWEST
SOUTHEAST
COASTAL
72"
76"
80"
84"
88"
92"
96"
100"
68"
Memphis WB AP, Tenn.
Moscow, Tenn.
Bolivar 2, Tenn.
Selmer, Tenn.
Savannah, Tenn.
Pickwick Landing Dam, Tenn.
Madison, Ark.
Helena, Ark.
St. Charles, Ark.
Dumas 1 ESE, Ark.
Arkansas City, Ark.
Dermott, Ark.
Portland, Ark.
Lake Providence, La.
Tallulah Delta Lab., La.
St. Joseph Exp. Sta., La.
Jonesville, La.
Vidalia Natchez, La.
Acme, La.
Angola, La.
Clinton, La.
Franklinton, La.
Bogalusa, La.
Enon 7 WSW, La.
Pearl River, La.
Waterloo, Ala.
Bishop, Ala.
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Vernon, Ala.
Reform, Ala.
Pickensville, Ala.
Aliceville 2 SE, Ala.
Dancy 3 N, Ala.
Gainesville, Ala.
Livingston, Ala.
Cuba, Ala.
Pushmataha, Ala.
Melvin, Ala.
Gilbertown, Ala.
Jackson Lock 1, Ala.
Chatom, Ala.
Citronelle, Ala.
Mobile WB AP, Ala.
Fort Morgan, Ala.
Lake Cormorant 1 W
Pleasant Hill
Hernando
Mount Pleasant
Holly Springs 4 N
Holly Springs 2
Ashland
Tunica
Tunica 2
Arkabutla Dam
Independence 3 N
Senatobia
Sarah
Hickory Flat 1 NW
Ripley
Corinth
Acton
Burnsville Substa
Midway
Tishomingo
Booneville
Belmont
Baldwyn
Abbeville
New Albany
Sledge
Sardis Dam
University
Lafayette Springs
Batesville
Clarksdale
Clarksdale 2
Lambert
Water Valley
Enid Dam
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Pontotoc Exp Sta
Sarepta
Bruce
Okolona
Amory 4 W
Charleston
Coffeeville
Grenada Dam
Calhoun City
Van Vleet
Houston 2 NE
Aberdeen
Swan Lake 1 S
Cleveland 3 N
Cleveland
Winter City
Holcomb
Grenada
Dane
Elliott
Eupora
West Point
Tibbee
Columbus 4 NNE
State College
Greenwood
Greenwood 2
Greenwood FAA AP
Carrollton 1 SSW
Scott
Stoneville Exp Sta
Greenville
Greenville 8 SW
Moorhead
Belzoni
Blackhawk
Vaiden
Ackerman
Bluff Lake
Crawford 5 WSW
Brookaville Exp Sta
Macon 2 NE
Lexington
Kosciusko
Louisville
Nitta Yuma
Rolling Fork
Holly Bluff
Yazoo City
Pickens
Edinburg
Philadelphia 1 WSW
Gholson
Shuqualak
Onward
Porterville
Kipling
Germania
Canton
Ofahoma
Carthage
Walnut Grove
Union
Collinsville 3 NE
Decatur
Russell 2 WNW
Goshen Springs 2 N
Forest
Newton Exp Sta
Hickory
Meridian WB AP
Vicksburg WB City
Jackson WB AP
Pelahatchie
Clinton Exp Sta
Raymond Exp Sta
Montrose
Enterprise
Utica
Crandall 12 N
Paulding
Quitman
Port Gibson
Crystal Springs 4 NNE
Dlo
Sylvarena 1 W
Bay Springs
Heidelberg
Shubuta 2
Alcorn A & M College
Lorman
Mize
Rockport
Barlow 8 SE
Laurel
Waynesboro 3 WNW
Waynesboro 1 E
Prentiss 2 NNE
Collins
Brookhaven
Monticello 2 S
Natchez
Meadville
Richton 12 NNE
Buckatunna
Lovett
Ruth
Sumrall
Hattiesburg
Richton 2 N
State Line
Bude Fire Tower
Columbia
McComb FAA AP
Liberty 3
Beaumont
Leakesville
Purvis
Woodville
Centreville 1 S
Tylertown
Lumberton 2 N
Brooklyn 2 SE
Kentwood
Merrill
Wiggins
Poplarville Exp. Station
White Sand
McHenry 5 ESE
Mc Neill Exp Forest
Saucier Exp Forest
Vancleave
Stennard
Picayune 5 S
Gulfport Naval Center
Pascagoula Jr High Sch
Biloxi City
Pascagoula Ing Ship Yd
Bay St Louis
Pearlington
STATION LEGEND
○ ● ◉ Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: ○ Non-recording; ● Recording; ◉ Both types.
Double circle combinations indicate the availability of more detailed meteorological data.

Figure 2.—Greatest annual precipitation 1891-1958.

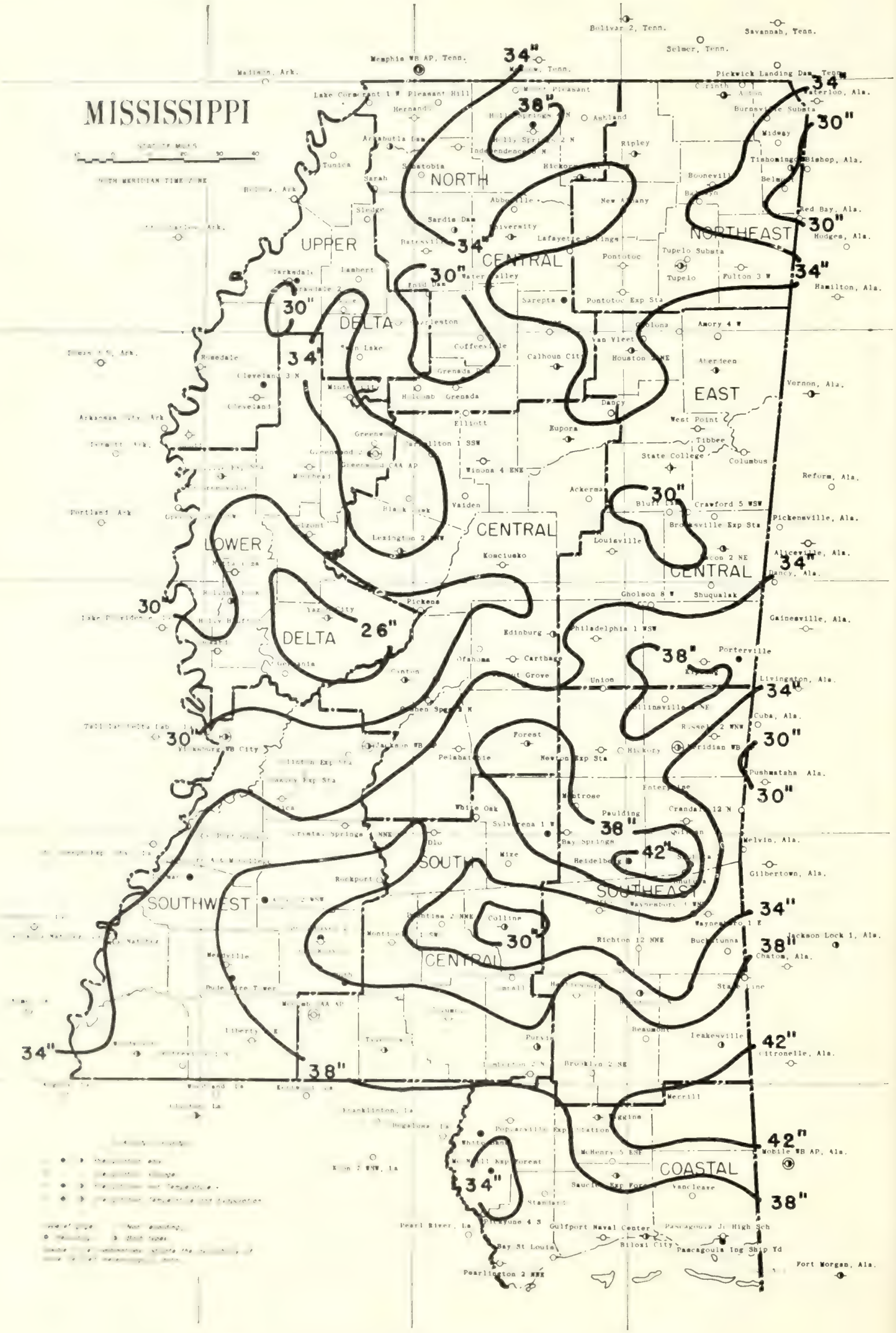

MISSISSIPPI
UPPER DELTA
NORTH CENTRAL
NORTHEAST
LOWER DELTA
CENTRAL
EAST CENTRAL
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
COASTAL
34"
38"
30"
34"
30"
34"
30"
30"
34"
34"
30"
34"
30"
26"
30"
38"
34"
30"
30"
30"
38"
42"
30"
34"
38"
34"
38"
42"
42"
34"
38"
Memphis WB AP, Tenn.
Bolivar 2, Tenn.
Selmer, Tenn.
Savannah, Tenn.
Pickwick Landing Dam, Tenn.
Waterloo, Ala.
Bishop, Ala.
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Vernon, Ala.
Reform, Ala.
Pickensville, Ala.
Aliceville, Ala.
Gainesville, Ala.
Livingston, Ala.
Cuba, Ala.
Pushmataha, Ala.
Melvin, Ala.
Gilbertown, Ala.
Jackson Lock 1, Ala.
Chatom, Ala.
Citronelle, Ala.
Mobile WB AP, Ala.
Fort Morgan, Ala.
Holly Springs
Ashland
Ripley
Corinth
Booneville
Tupelo
New Albany
Pontotoc
Oxford
Batesville
Sardis Dam
Enid Dam
Water Valley
Charleston
Coffeeville
Grenada
Calhoun City
Houston
Aberdeen
West Point
Columbus
State College
Eupora
Winona 4 ENE
Greenwood
Greenville
Cleveland
Clarksdale
Tunica
Lexington
Kosciusko
Louisville
Macon
Shuqualak
Philadelphia
Yazoo City
Canton
Pickens
Carthage
Union
Meridian WB
Forest
Newton Exp Sta
Vicksburg WB City
Jackson WB
Pelahatchie
Crystal Springs
Hazlehurst
Brookhaven
Natchez
Meadville
Liberty
McComb
Collins
Laurel
Heidelberg
Waynesboro
Richton
Hattiesburg
Beaumont
Leakesville
Lumberton
Poplarville
Picayune
Merrill
Wiggins
Saucier
Vancleave
Gulfport Naval Center
Biloxi City
Pascagoula
Bay St Louis
Pearlington

Figure 3.—Least annual precipitation, 1891-1958.

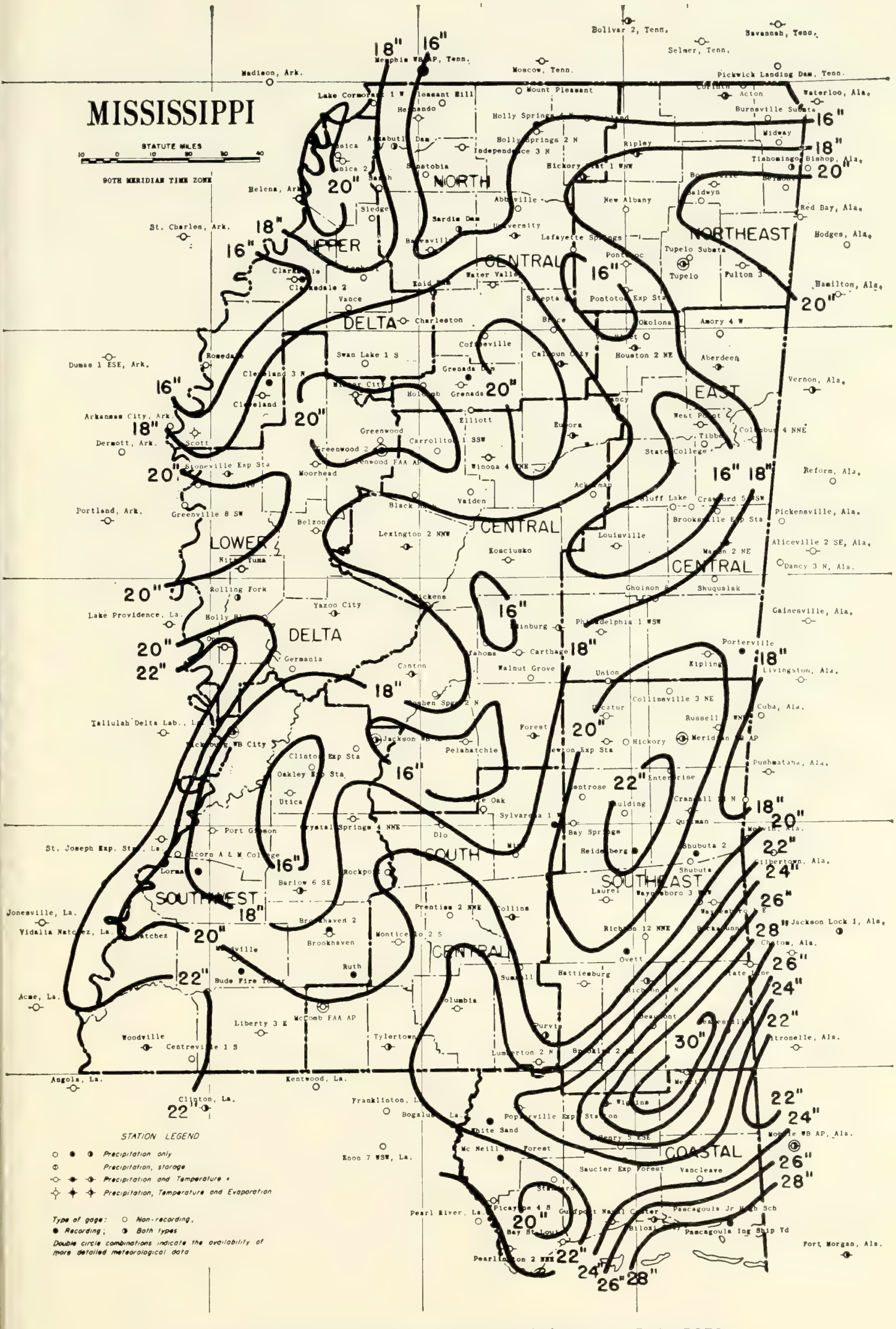

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER
DELTA
LOWER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
CENTRAL
SOUTHWEST
SOUTH
CENTRAL
SOUTHEAST
COASTAL
16"
18"
20"
22"
24"
26"
28"
30"
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: ○ Non-recording, ● Recording; ◑ Both types
Double circle combinations indicate the availability of more detailed meteorological data

Figure 4.—Greatest monthly precipitation, 1891-1958.

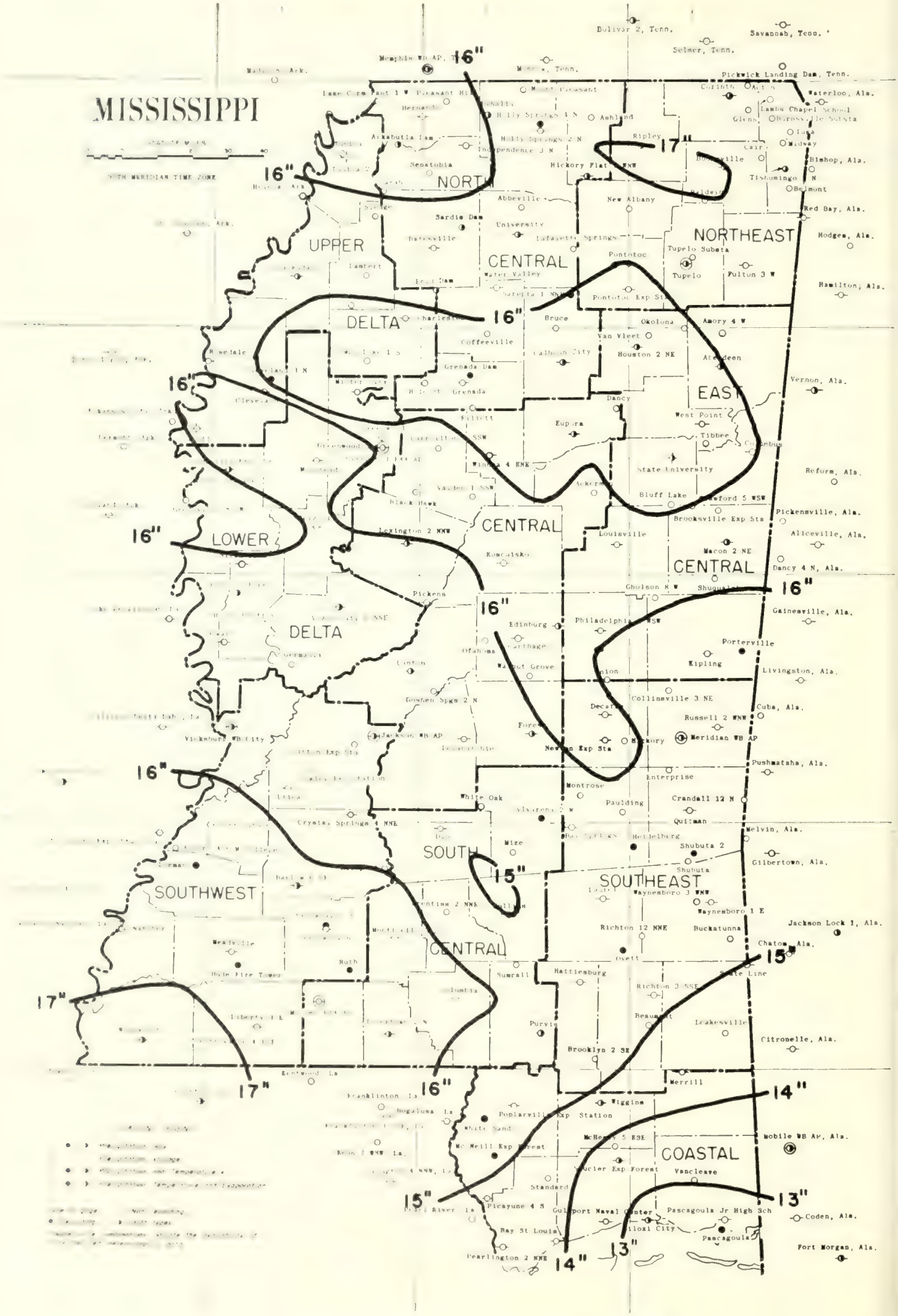

MISSISSIPPI
16"
17"
16"
16"
16"
16"
16"
16"
16"
15"
17"
17"
16"
15"
15"
14"
13"
14"
13"
NORTH
UPPER
CENTRAL
NORTHEAST
DELTA
EAST
CENTRAL
LOWER
CENTRAL
DELTA
SOUTH
SOUTHWEST
SOUTHEAST
CENTRAL
COASTAL
Bolivar 2, Tenn.
Savannah, Tenn.
Selmer, Tenn.
Memphis WB AP, Tenn.
Pickwick Landing Dam, Tenn.
Waterloo, Ala.
Corinth
Lambs Chapel School
Ashland
Ripley
Holly Springs 4 N
Holly Springs 2 N
Independence 3 N
Senatobia
Arkabutla Dam
Hernando
Hickory Flat 1 WNW
Booneville
Bishop, Ala.
Tishomingo 1 N
Belmont
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Abbeville
Sardis Dam
University
Batesville
Lafayette Springs
New Albany
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Lambert
Enid Dam
Water Valley
Pontotoc Exp Sta
Charleston
Bruce
Okolona
Amory 4 W
Coffeeville
Van Vleet
Houston 2 NE
Calhoun City
Aberdeen
Grenada Dam
Grenada
Dancy
West Point
Vernon, Ala.
Eupora
Tibbee
Columbus
Greenwood
Winona 4 ENE
State University
Reform, Ala.
Ackerman
Bluff Lake
Crawford 5 WSW
Pickensville, Ala.
Brooksville Exp Sta
Aliceville, Ala.
Black Hawk
Lexington 2 WNW
Kosciusko
Louisville
Macon 2 NE
Dancy 4 N, Ala.
Ghoulson 8 W
Pickens
Edinburg
Philadelphia 4 WSW
Gainesville, Ala.
Porterville
Carthage
Ofahoma
Walnut Grove
Kipling
Livingston, Ala.
Canton
Union
Collinsville 3 NE
Goshen Spgs 2 N
Decatur
Cuba, Ala.
Russell 2 WNW
Forest
Vicksburg WB City
Jackson WB AP
Newton Exp Sta
Hickory
Meridian WB AP
Pushmataha, Ala.
Enterprise
Montrose
White Oak
Paulding
Crandall 12 N
Crystal Springs 4 NNE
Quitman
Melvin, Ala.
Heidelberg
Mize
Shubuta 2
Shubuta
Gilbertown, Ala.
Waynesboro 3 WNW
Waynesboro 1 E
Prentiss 2 NNE
Collins
Richton 12 NNE
Buckatunna
Jackson Lock 1, Ala.
Chatom, Ala.
Meadville
Ovett
Ruth
Hattiesburg
State Line
Sumrall
Richton 3 SSE
Beaumont
Leakesville
Citronelle, Ala.
Purvis
Brooklyn 2 SE
Merrill
Kentwood, La.
Franklinton, La.
Bogalusa, La.
Poplarville Exp Station
Wiggins
White Sand
McHenry 5 ESE
Mobile WB AP, Ala.
McNeill Exp Forest
Saucier Exp Forest
Vancleave
Standard
Picayune 4 S
Gulfport Naval Center
Pascagoula Jr High Sch
Coden, Ala.
Pearl River, La.
Bay St Louis
Biloxi City
Pascagoula
Pearlington 2 WNW
Fort Morgan, Ala.

Figure 5.—Mean winter precipitation, 1931-60.

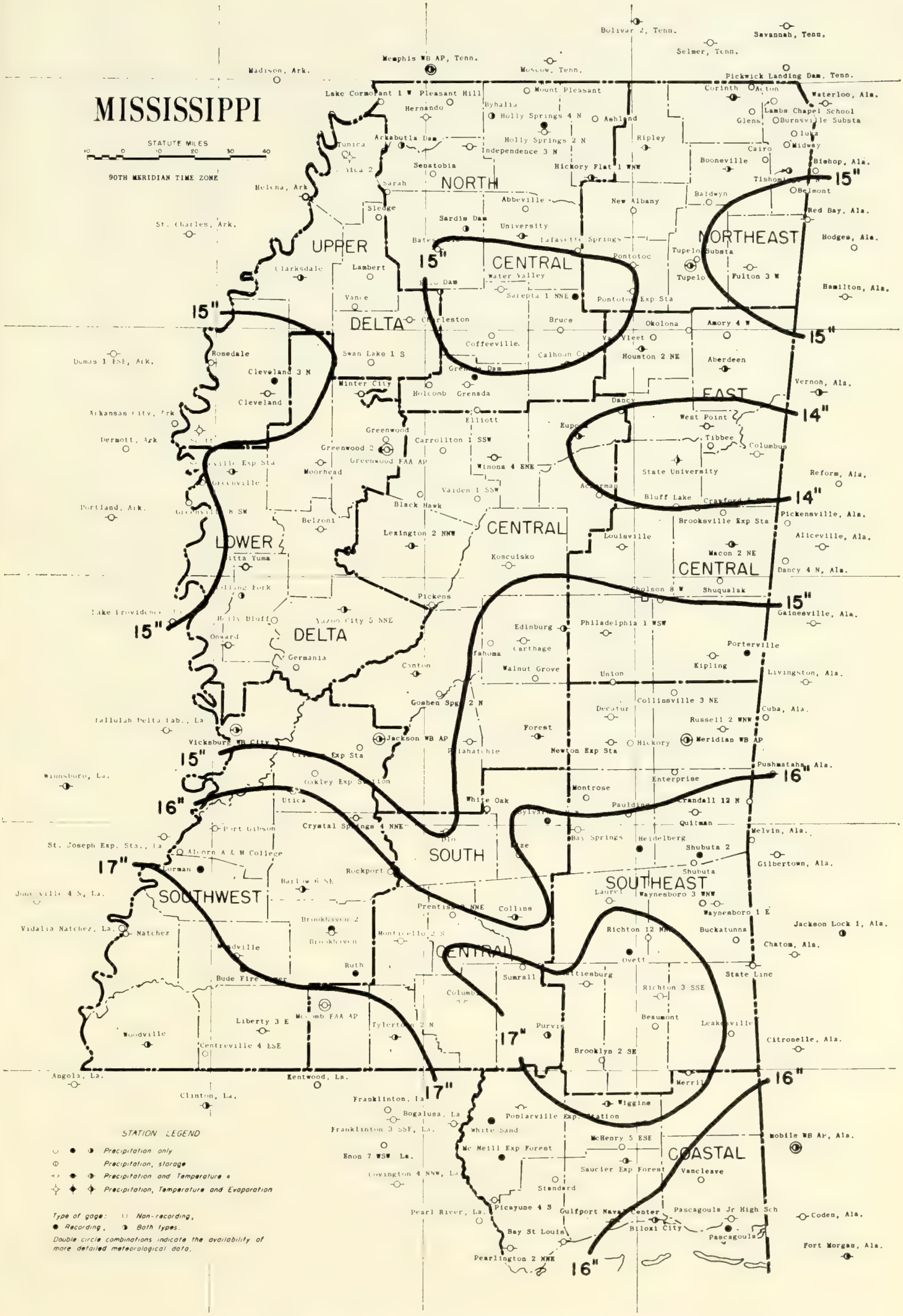

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER DELTA
NORTH CENTRAL
NORTHEAST
LOWER DELTA
CENTRAL
EAST CENTRAL
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
COASTAL
15"
14"
16"
17"
Memphis WB AP, Tenn.
Jackson WB AP
Vicksburg WB City
Meridian WB AP
Mobile WB AP, Ala.
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording, Recording, Both types.
Double circle combinations indicate the availability of more detailed meteorological data.

Figure 6.—Man spring precipitation, 1931-60.

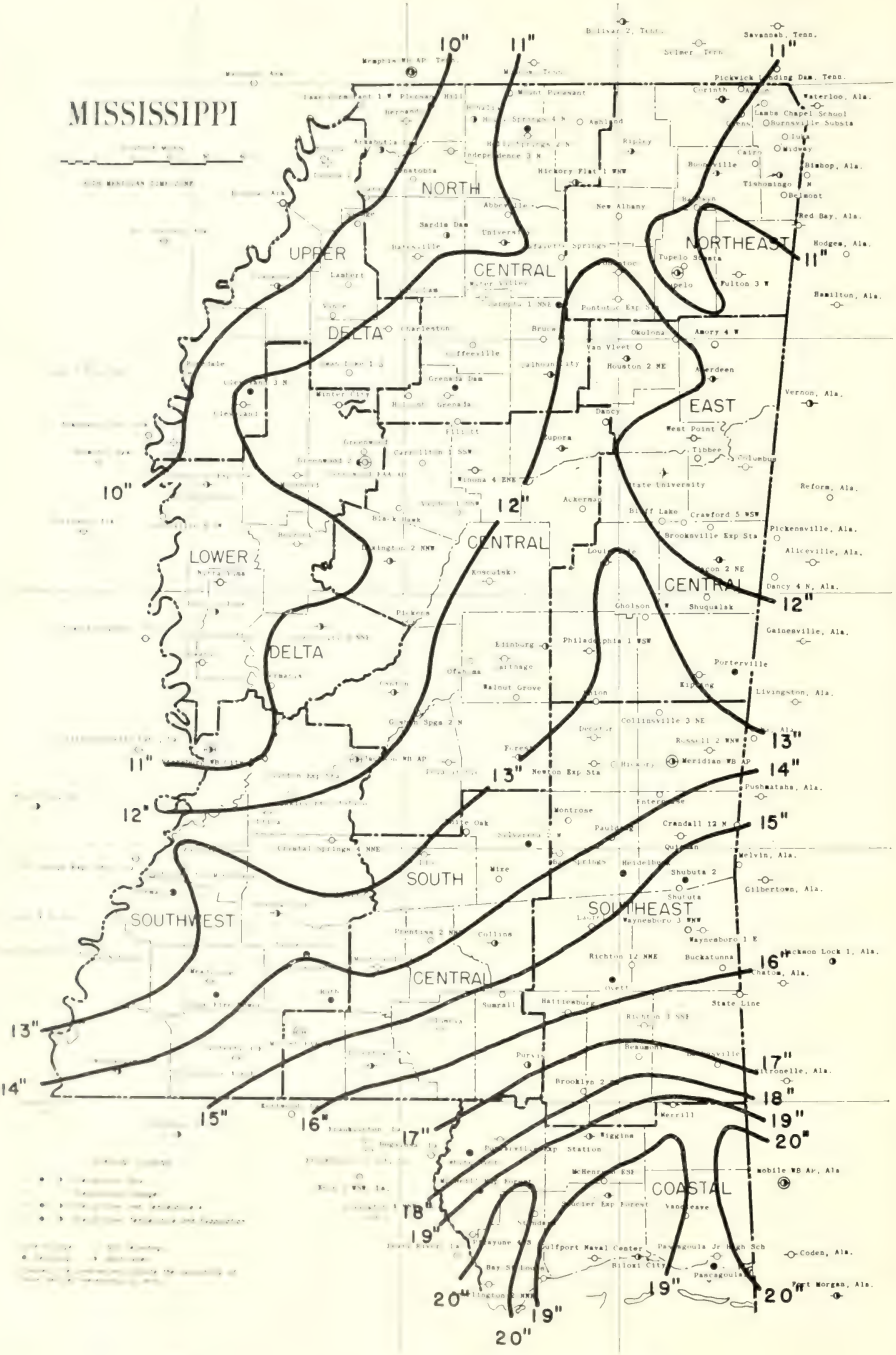

MISSISSIPPI
UPPER DELTA
NORTH CENTRAL
NORTHEAST
LOWER DELTA
CENTRAL
EAST CENTRAL
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
COASTAL
10"
11"
12"
13"
14"
15"
16"
17"
18"
19"
20"
Memphis WB AP, Tenn.
Bolivar 2, Tenn.
Selmer, Tenn.
Savannah, Tenn.
Pickwick Landing Dam, Tenn.
Waterloo, Ala.
Corinth
Iuka
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Tupelo
Fulton 3 W
Amory 4 W
Aberdeen
Vernon, Ala.
West Point
Columbus
State University
Reform, Ala.
Pickensville, Ala.
Aliceville, Ala.
Macon 2 NE
Shuqualak
Gainesville, Ala.
Porterville
Livingston, Ala.
Meridian WB AP
Pushmataha, Ala.
Waynesboro 1 E
Jackson Lock 1, Ala.
Hattiesburg
Citronelle, Ala.
Mobile WB AP, Ala.
Pascagoula
Biloxi City
Coden, Ala.
Fort Morgan, Ala.
Grenada
Greenwood
Sardis Dam
Kosciusko
Philadelphia
Newton Exp Sta
Collins
Wiggins
Gulfport Naval Center
Bay St Louis
Picayune

Figure 7.—Mean summer precipitation, 1931-60.

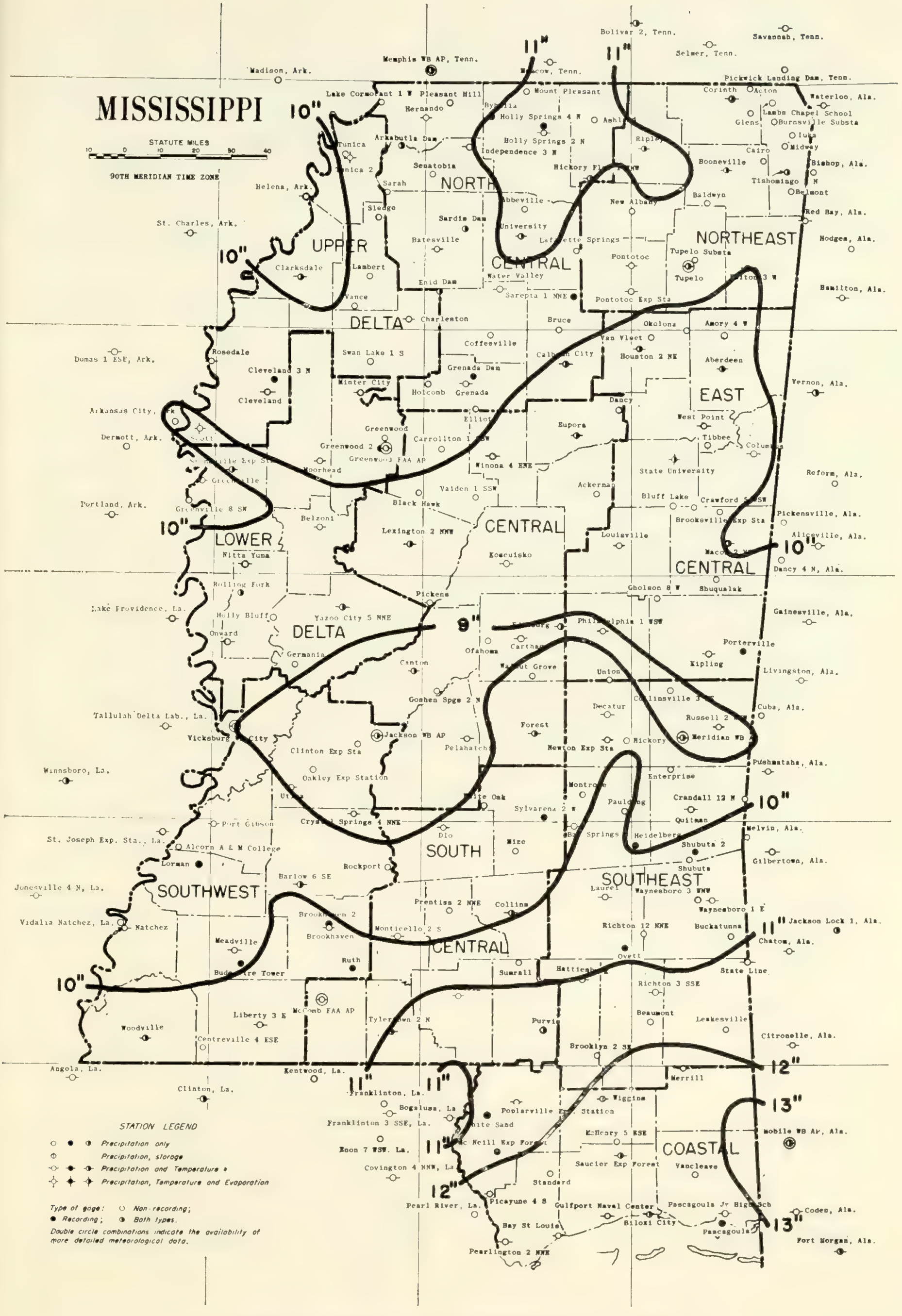

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
LOWER
DELTA
CENTRAL
SOUTHWEST
SOUTH
CENTRAL
SOUTHEAST
COASTAL
9"
10"
11"
12"
13"
Bolivar 2, Tenn.
Savannah, Tenn.
Selmer, Tenn.
Memphis WB AP, Tenn.
Moscow, Tenn.
Madison, Ark.
Pickwick Landing Dam, Tenn.
Corinth
Acton
Waterloo, Ala.
Lake Cormorant 1 W
Pleasant Hill
Mount Pleasant
Hernando
Byhalia
Holly Springs 4 N
Ashland
Lambs Chapel School
Glens
Burnsville Substa
Iuka
Tunica
Arkabutla Dam
Holly Springs 2 N
Independence 3 W
Ripley
Cairo
Midway
Tunica 2
Senatobia
Hickory Flat 1 WNW
Booneville
Bishop, Ala.
Helena, Ark.
Sarah
Tishomingo
Belmont
Abbeville
New Albany
Baldwyn
Sledge
Sardis Dam
Red Bay, Ala.
St. Charles, Ark.
University
Batesville
Lafayette Springs
Hodges, Ala.
Clarksdale
Lambert
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Water Valley
Enid Dam
Sarepta 1 NNE
Pontotoc Exp Sta
Hamilton, Ala.
Vance
Charleston
Bruce
Okolona
Amory 4 W
Coffeeville
Van Vleet
Dumas 1 ESE, Ark.
Rosedale
Swan Lake 1 S
Calhoun City
Houston 2 NE
Aberdeen
Cleveland 3 N
Grenada Dam
Minter City
Holcomb
Grenada
Vernon, Ala.
Cleveland
Dancy
Arkansas City, Ark.
Elliott
West Point
Dermott, Ark.
Scott
Greenwood
Eupora
Tibbee
Columbus
Carrollton 1 SW
Greenwood 2
Greenwood FAA AP
Stoneville Exp Sta
Winona 4 ENE
State University
Moorhead
Reform, Ala.
Greenville
Ackerman
Valden 1 SSW
Bluff Lake
Crawford 5 SSW
Portland, Ark.
Black Hawk
Greenville 8 SW
Belzoni
Brooksville Exp Sta
Pickensville, Ala.
Lexington 2 NNW
Louisville
Aliceville, Ala.
Macon 2 W
Nitta Yuma
Kosciusko
Dancy 4 N, Ala.
Rolling Fork
Gholson 8 W
Shuqualak
Pickens
Lake Providence, La.
Gainesville, Ala.
Holly Bluff
Yazoo City 5 NNE
Edinburg
Philadelphia 1 WSW
Onward
Carthage
Porterville
Ofahoma
Germania
Kipling
Canton
Walnut Grove
Union
Livingston, Ala.
Collinsville 3
Goshen Spgs 2 N
Decatur
Russell 2
Cuba, Ala.
Tallulah Delta Lab., La.
Forest
Jackson WB AP
Hickory
Meridian WB AP
Vicksburg
City
Pelahatchie
Newton Exp Sta
Clinton Exp Sta
Pushmataha, Ala.
Winnsboro, La.
Oakley Exp Station
Enterprise
Montrose
Utica
White Oak
Paulding
Crandall 12 N
Sylvarena 2 W
Crystal Springs 4 NNE
Quitman
Port Gibson
Dlo
Bay Springs
Heidelberg
Melvin, Ala.
St. Joseph Exp. Sta., La.
Alcorn A & M College
Mize
Shubuta 2
Lorman
Rockport
Shubuta
Gilbertown, Ala.
Barlow 6 SE
Jonesville 4 N, La.
Laurel
Waynesboro 3 WNW
Prentiss 2 NNE
Collins
Waynesboro 1 E
Brookhaven 2
Vidalia Natchez, La.
Natchez
Richton 12 NNE
Buckatunna
Jackson Lock 1, Ala.
Brookhaven
Monticello 2 S
Meadville
Chatom, Ala.
Ovett
Ruth
Sumrall
Hattiesburg
State Line
Bude Fire Tower
Richton 3 SSE
McComb FAA AP
Liberty 3 E
Beaumont
Tylertown 2 N
Purvis
Leakesville
Woodville
Citronelle, Ala.
Centreville 4 ESE
Brooklyn 2 SE
Angola, La.
Kentwood, La.
Merrill
Clinton, La.
Franklinton, La.
Wiggins
Bogalusa, La.
Poplarville Exp. Station
Franklinton 3 SSE, La.
White Sand
McHenry 5 ESE
Mobile WB AP, Ala.
Enon 7 WSW, La.
McNeill Exp Forest
Saucier Exp Forest
Vancleave
Covington 4 NNW, La.
Standard
Picayune 4 S
Gulfport Naval Center
Pascagoula Jr High Sch
Coden, Ala.
Pearl River, La.
Bay St Louis
Biloxi City
Pascagoula
Fort Morgan, Ala.
Pearlington 2 NNE
STATION LEGEND
○ ● ◑ Precipitation only
⊕ Precipitation, storage
-○- -●- -◑- Precipitation and Temperature
✧ ✦ ✦ Precipitation, Temperature and Evaporation
Type of gage: ○ Non-recording; ● Recording; ◑ Both types.
Double circle combinations indicate the availability of more detailed meteorological data.

Figure 8.—Mean fall precipitation, 1931-60.

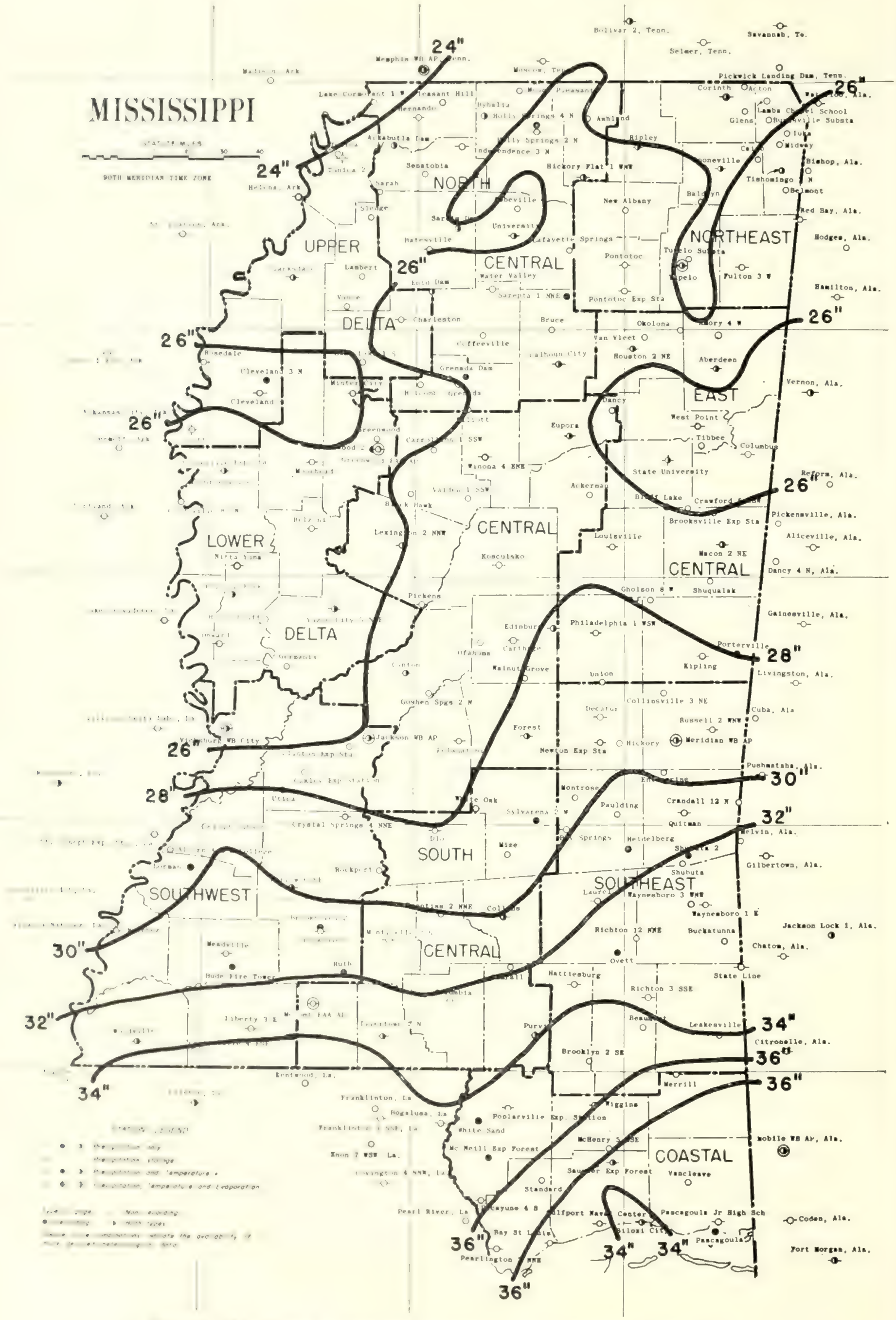

MISSISSIPPI
90TH MERIDIAN TIME ZONE
UPPER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
LOWER
DELTA
CENTRAL
SOUTH
CENTRAL
SOUTHWEST
SOUTHEAST
COASTAL
24"
24"
26"
26"
26"
26"
26"
26"
26"
28"
28"
30"
30"
32"
32"
34"
34"
34"
34"
36"
36"
36"
36"
Bolivar 2, Tenn.
Savannah, Tn.
Selmer, Tenn.
Memphis WB AP, Tenn.
Pickwick Landing Dam, Tenn.
Corinth
Acton
Lambs Chapel School
Glens
Booneville Substa
Iuka
Midway
Bishop, Ala.
Tishomingo
Belmont
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Lake Cormorant 1 W
Pleasant Hill
Hernando
Holly Springs 4 N
Ashland
Ripley
Arkabutla Dam
Holly Springs 2 N
Independence 3 N
Hickory Flat 1 WNW
Booneville
Senatobia
Tunica 2
Helena, Ark.
Sarah
Sledge
Batesville
Oxford
University
Lafayette Springs
New Albany
Baldwyn
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Lambert
Enid Dam
Water Valley
Sarepta 1 NNE
Pontotoc Exp Sta
Charleston
Bruce
Okolona
Amory 4 W
Coffeeville
Van Vleet
Houston 2 NE
Aberdeen
Calhoun City
Rosedale
Cleveland 3 N
Cleveland
Grenada Dam
Minter City
Holcomb
Grenada
Dancy
Vernon, Ala.
West Point
Eupora
Tibbee
Columbus
Greenwood
Carrollton 1 SSW
Winona 4 ENE
State University
Reform, Ala.
Ackerman
Bluff Lake
Crawford
Brooksville Exp Sta
Pickensville, Ala.
Aliceville, Ala.
Black Hawk
Lexington 2 NNW
Louisville
Koscuisko
Macon 2 NE
Shuqualak
Dancy 4 N, Ala.
Pickens
Gholson 8 W
Gainesville, Ala.
Edinburg
Philadelphia 1 WSW
Carthage
Porterville
Kipling
Livingston, Ala.
Canton
Walnut Grove
Union
Collinsville 3 NE
Cuba, Ala
Goshen Spgs 2 N
Decatur
Russell 2 WNW
Forest
Hickory
Meridian WB AP
Vicksburg WB City
Jackson WB AP
Newton Exp Sta
Pushmataha, Ala.
Utica
Crystal Springs 4 NNE
White Oak
Montrose
Enterprise
Crandall 12 N
Paulding
Sylvarena
Quitman
Melvin, Ala.
Rose Springs
Heidelberg
Shubuta 2
Gilbertown, Ala.
Mize
Shubuta
Natchez
Rockport
Laurel
Waynesboro 3 WNW
Waynesboro 1 E
Prentiss 2 NNE
Collins
Richton 12 NNE
Buckatunna
Jackson Lock 1, Ala.
Meadville
Chatom, Ala.
Ruth
Ovett
Bude Fire Tower
Hattiesburg
State Line
Richton 3 SSE
Liberty 3 E
McComb FAA AP
Purvis
Beaumont
Leakesville
Citronelle, Ala.
Brooklyn 2 SE
Kentwood, La.
Merrill
Franklinton, La
Wiggins
Bogalusa, La
Poplarville Exp. Station
White Sand
McHenry 5 SSE
Mobile WB AP, Ala.
Mc Neill Exp Forest
Enon 7 WSW La.
Saucier Exp Forest
Vancleave
Covington 4 NNW, La.
Standard
Picayune 4 S
Gulfport Naval Center
Pascagoula Jr High Sch
Coden, Ala.
Pearl River, La
Biloxi City
Pascagoula
Bay St Louis
Pearlington 2 WNW
Fort Morgan, Ala.

Figure 9.—Mean growing season precipitation, 1931-60.

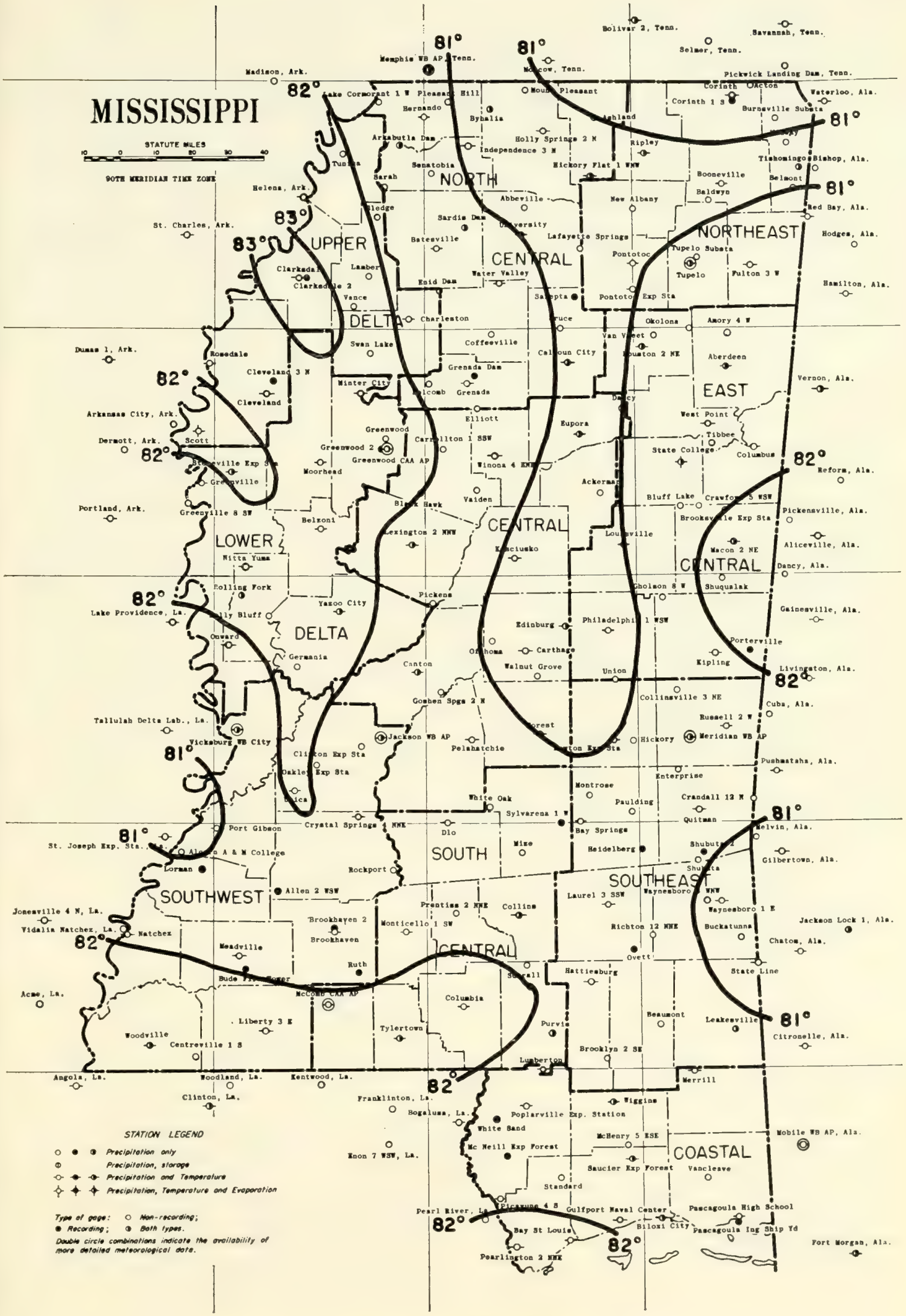

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER
DELTA
LOWER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
CENTRAL
SOUTH
CENTRAL
SOUTHEAST
SOUTHWEST
COASTAL
81°
82°
83°
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording; Recording; Both types.
Double circle combinations indicate the availability of more detailed meteorological data.
Memphis WB AP, Tenn.
Moscow, Tenn.
Bolivar 2, Tenn.
Selmer, Tenn.
Savannah, Tenn.
Pickwick Landing Dam, Tenn.
Madison, Ark.
Helena, Ark.
St. Charles, Ark.
Dumas 1, Ark.
Arkansas City, Ark.
Dermott, Ark.
Portland, Ark.
Lake Providence, La.
Tallulah Delta Lab., La.
St. Joseph Exp. Sta., La.
Jonesville 4 N, La.
Vidalia Natchez, La.
Acme, La.
Angola, La.
Woodland, La.
Clinton, La.
Kentwood, La.
Franklinton, La.
Bogalusa, La.
Enon 7 WSW, La.
Pearl River, La.
Waterloo, Ala.
Bishop, Ala.
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Vernon, Ala.
Reform, Ala.
Pickensville, Ala.
Aliceville, Ala.
Dancy, Ala.
Gainesville, Ala.
Livingston, Ala.
Cuba, Ala.
Pushmataha, Ala.
Melvin, Ala.
Gilbertown, Ala.
Jackson Lock 1, Ala.
Chatom, Ala.
Citronelle, Ala.
Mobile WB AP, Ala.
Fort Morgan, Ala.
Lake Cormorant 1 W
Pleasant Hill
Hernando
Byhalia
Mount Pleasant
Holly Springs 2 N
Independence 3 N
Arkabutla Dam
Tunica
Senatobia
Sarah
Corinth
Acton
Corinth 1 S
Burnsville Substa
Ashland
Ripley
Hickory Flat 1 WNW
Tishomingo
Booneville
Belmont
Baldwyn
New Albany
Abbeville
University
Sardis Dam
Batesville
Sledge
Lafayette Springs
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Pontotoc Exp Sta
Clarksdale
Clarksdale 2
Lambert
Vance
Water Valley
Enid Dam
Saltepta
Charleston
Coffeeville
Swan Lake
Bruce
Okolona
Amory 4 W
Van Vleet
Houston 2 NE
Aberdeen
Calhoun City
Rosedale
Cleveland 3 N
Cleveland
Minter City
Grenada Dam
Holcomb
Grenada
Elliott
Dancy
West Point
Tibbee
State College
Columbus
Scott
Stoneville Exp Sta
Greenville
Greenville 8 SW
Greenwood
Greenwood 2
Greenwood CAA AP
Moorhead
Carrollton 1 SSW
Winona 4 ENE
Eupora
Ackerman
Vaiden
Black Hawk
Belzoni
Lexington 2 WNW
Kosciusko
Louisville
Bluff Lake
Crawford 5 WSW
Brooksville Exp Sta
Macon 2 NE
Nitta Yuma
Rolling Fork
Yazoo City
Holly Bluff
Onward
Germania
Pickens
Sholson 8 W
Shuqualak
Edinburg
Philadelphia 1 WSW
Ofahoma
Carthage
Walnut Grove
Union
Porterville
Kipling
Canton
Collinsville 3 NE
Goshen Spgs 2 N
Forest
Newton Exp Sta
Hickory
Russell 2 W
Meridian WB AP
Vicksburg WB City
Jackson WB AP
Pelahatchie
Clinton Exp Sta
Oakley Exp Sta
Utica
Enterprise
Montrose
Paulding
Crandall 12 N
White Oak
Sylvarena 1 W
Bay Springs
Quitman
Port Gibson
Crystal Springs 4 NNE
Dlo
Mize
Heidelberg
Shubuta 2
Shubuta
Alcorn A & M College
Lorman
Rockport
Allen 2 WSW
Laurel 3 SSW
Waynesboro 2 WNW
Waynesboro 1 E
Natchez
Brookhaven 2
Brookhaven
Prentiss 2 NNE
Collins
Monticello 1 SW
Richton 12 NNE
Buckatunna
Meadville
Ovett
Ruth
Sumrall
Hattiesburg
State Line
Bude Fire Tower
McComb CAA AP
Columbia
Liberty 3 E
Beaumont
Leakesville
Woodville
Centreville 1 S
Tylertown
Purvis
Brooklyn 2 SE
Lumberton
Merrill
Wiggins
Poplarville Exp. Station
White Sand
McHenry 5 ESE
McNeill Exp Forest
Saucier Exp Forest
Vancleave
Standard
Picayune 4 S
Gulfport Naval Center
Biloxi City
Pascagoula High School
Pascagoula Ing Ship Yd
Bay St Louis
Pearlington 2 NNE

Figure 10.—Man July temperature, 1931, 1960.

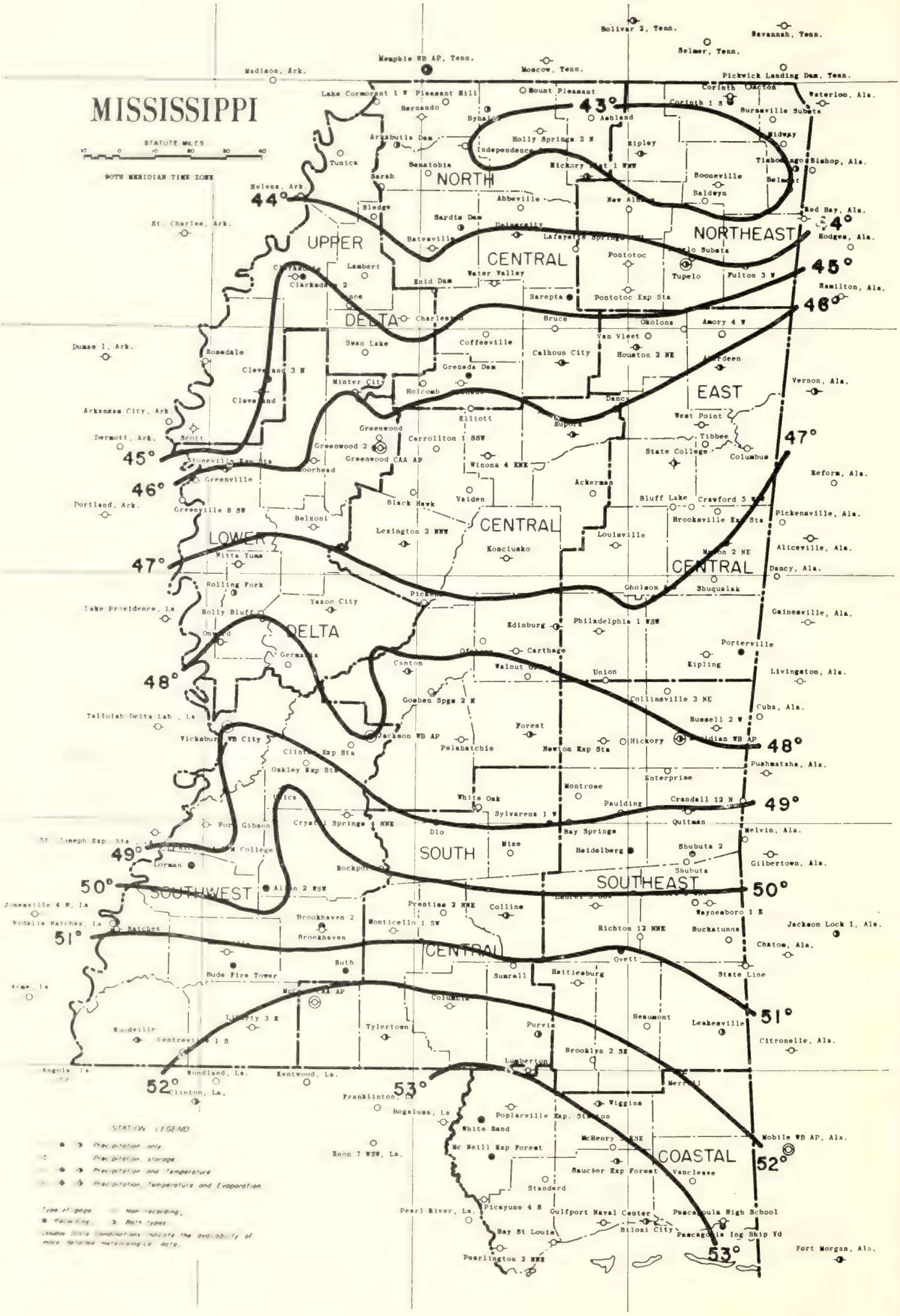
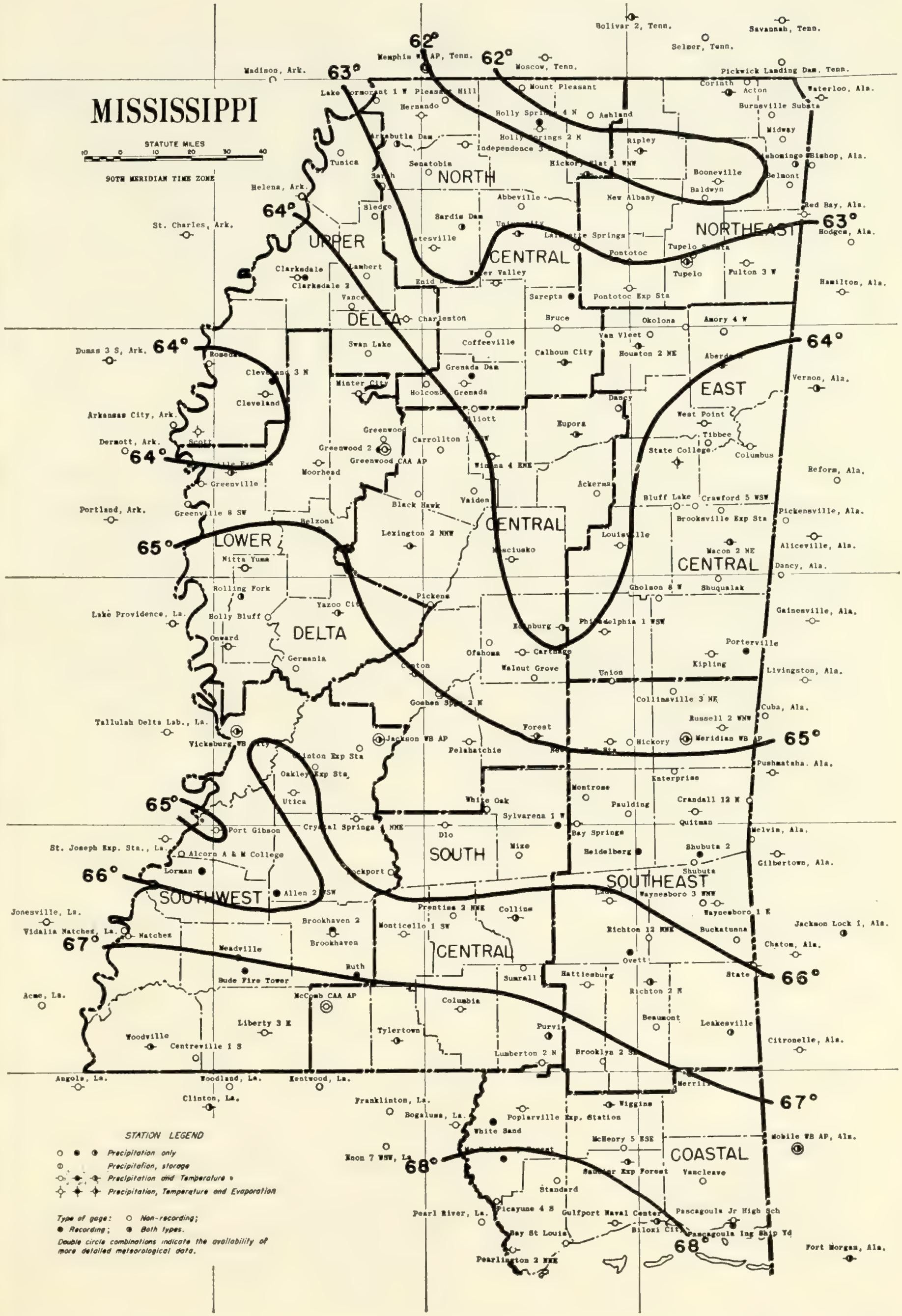

MISSISSIPPI
STATUTE MILES
90TH MERIDIAN TIME ZONE
NORTH
NORTHEAST
UPPER
CENTRAL
DELTA
EAST
CENTRAL
LOWER
CENTRAL
DELTA
SOUTH
SOUTHEAST
SOUTHWEST
CENTRAL
COASTAL
43°
44°
45°
46°
47°
48°
49°
50°
51°
52°
53°
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage
Non recording
Recording
Both types
Memphis WB AP, Tenn.
Jackson WB AP
Meridian WB AP
Mobile WB AP, Ala.
Vicksburg WB City
Tupelo
Greenwood
Natchez
Hattiesburg
Gulfport Naval Center

Figure 11.—Mean January temperature, 1931-60.


MISSISSIPPI
STATUTE MILES
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90TH MERIDIAN TIME ZONE
62°
62°
63°
63°
64°
64°
64°
64°
65°
65°
65°
66°
66°
67°
67°
68°
68°
UPPER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
LOWER
DELTA
CENTRAL
SOUTH
CENTRAL
SOUTHEAST
SOUTHWEST
COASTAL
Bolivar 2, Tenn.
Savannah, Tenn.
Selmer, Tenn.
Memphis WB AP, Tenn.
Moscow, Tenn.
Madison, Ark.
Pickwick Landing Dam, Tenn.
Corinth
Acton
Waterloo, Ala.
Lake Cormorant 1 W
Pleasant Hill
Mount Pleasant
Hernando
Holly Springs 4 N
Ashland
Burnsville Substa
Arkabutla Dam
Holly Springs 2 N
Independence 3
Ripley
Midway
Tunica
Senatobia
Hickory Flat 1 WNW
Iuka
Booneville
Bishop, Ala.
Baldwyn
Belmont
Helena, Ark.
Sarah
Abbeville
New Albany
Red Bay, Ala.
Sledge
Sardis Dam
University
Hodges, Ala.
St. Charles, Ark.
Batesville
Lafayette Springs
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Clarksdale
Lambert
Water Valley
Clarksdale 2
Enid Dam
Hamilton, Ala.
Vance
Sarepta
Pontotoc Exp Sta
Charleston
Bruce
Okolona
Amory 4 W
Swan Lake
Coffeeville
Van Vleet
Dumas 3 S, Ark.
Rosedale
Calhoun City
Houston 2 NE
Aberdeen
Cleveland 3 N
Grenada Dam
Vernon, Ala.
Minter City
Holcomb
Grenada
Cleveland
Dancy
Arkansas City, Ark.
Elliott
Eupora
West Point
Greenwood
Carrollton 1 SSW
Tibbee
Dermott, Ark.
Scott
Greenwood 2
State College
Columbus
Stoneville Exp Sta
Greenwood CAA AP
Winona 4 ENE
Moorhead
Reform, Ala.
Greenville
Ackerman
Vaiden
Black Hawk
Bluff Lake
Crawford 5 WSW
Portland, Ark.
Greenville 8 SW
Pickensville, Ala.
Belzoni
Brooksville Exp Sta
Lexington 2 NNW
Louisville
Aliceville, Ala.
Macon 2 NE
Kosciusko
Nitta Yuma
Dancy, Ala.
Rolling Fork
Cholson 8 W
Shuqualak
Pickens
Yazoo City
Gainesville, Ala.
Lake Providence, La.
Holly Bluff
Edinburg
Philadelphia 1 WSW
Onward
Porterville
Ofahoma
Carthage
Kipling
Germania
Canton
Walnut Grove
Livingston, Ala.
Union
Collinsville 3 NE
Goshen Springs 2 N
Cuba, Ala.
Tallulah Delta Lab., La.
Russell 2 WNW
Vicksburg WB City
Forest
Jackson WB AP
Hickory
Meridian WB AP
Clinton Exp Sta
Pelahatchie
Newton Exp Sta
Pushmataha, Ala.
Oakley Exp Sta
Enterprise
Montrose
Utica
White Oak
Crandall 12 N
Paulding
Sylvarena 1 W
Quitman
Melvin, Ala.
Port Gibson
Crystal Springs 4 NNE
Dio
Bay Springs
St. Joseph Exp. Sta., La.
Mize
Shubuta 2
Alcorn A & M College
Heidelberg
Gilbertown, Ala.
Lorman
Hazlehurst
Rockport
Shubuta
Laurel
Waynesboro 3 WNW
Allen 2 SSW
Prentiss 2 NNE
Collins
Waynesboro 1 E
Jonesville, La.
Brookhaven 2
Monticello 1 SW
Richton 12 NNE
Buckatunna
Jackson Lock 1, Ala.
Vidalia Natchez, La.
Natchez
Brookhaven
Chatom, Ala.
Meadville
Ovett
Ruth
Sumrall
Hattiesburg
State Line
Bude Fire Tower
Richton 2 N
Acme, La.
McComb CAA AP
Columbia
Beaumont
Liberty 3 E
Leakesville
Tylertown
Purvis
Citronelle, Ala.
Woodville
Centreville 1 S
Lumberton 2 N
Brooklyn 2 SE
Angola, La.
Woodland, La.
Kentwood, La.
Merrill
Clinton, La.
Franklinton, La.
Wiggins
Bogalusa, La.
Poplarville Exp. Station
White Sand
Mobile WB AP, Ala.
McHenry 5 ESE
Enon 7 WSW, La.
Saucier Exp Forest
Vancleave
Standard
Pearl River, La.
Picayune 4 S
Gulfport Naval Center
Pascagoula Jr High Sch
Biloxi City
Bay St Louis
Pascagoula Ing Ship Yd
Fort Morgan, Ala.
Pearlington 2 NNE
STATION LEGEND
○ ● ◑ Precipitation only
⦶ Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: ○ Non-recording; ● Recording; ◑ Both types.
Double circle combinations indicate the availability of more detailed meteorological data.

Figure 12. Mean annual temperature, 1931-1960.

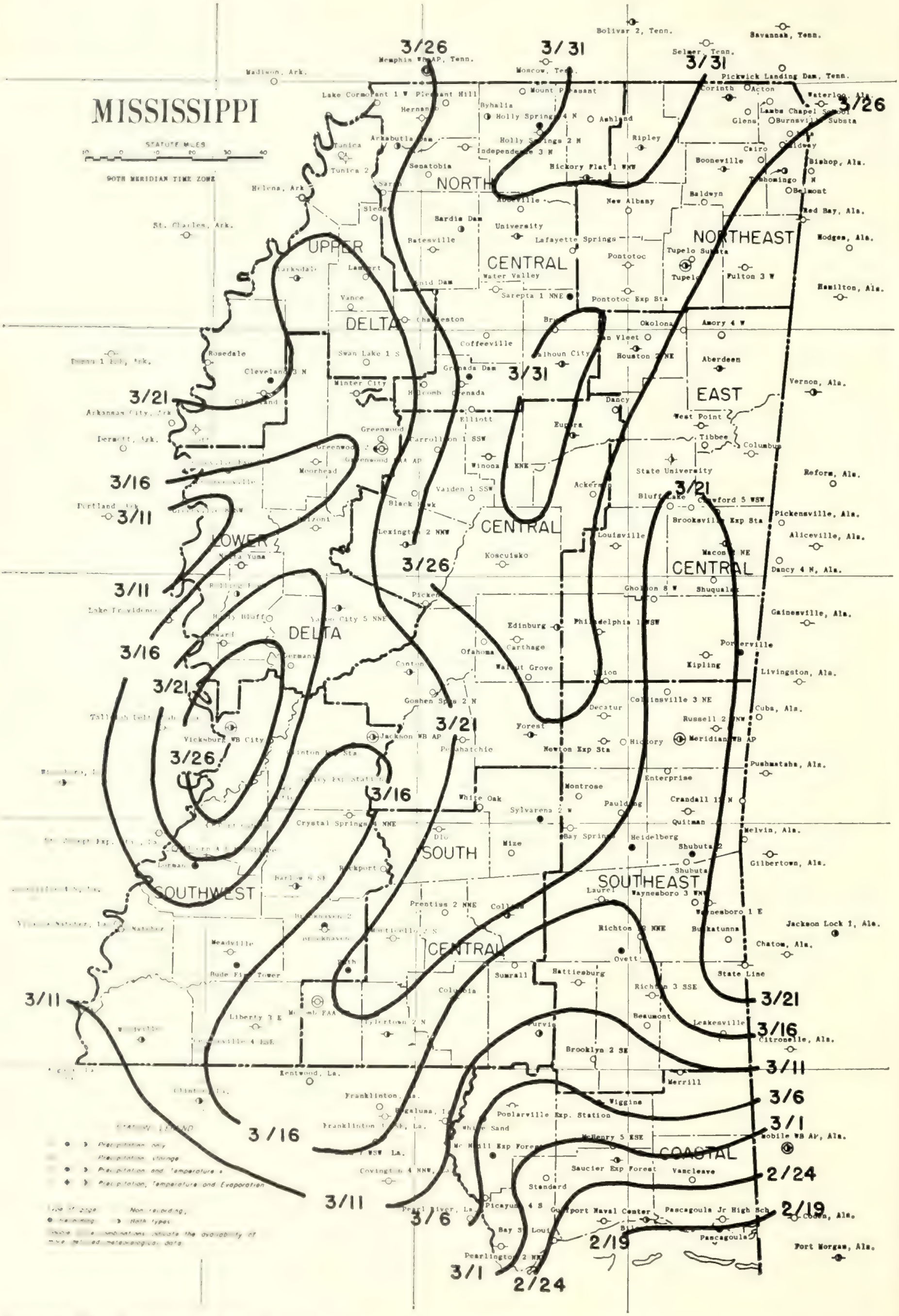

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
NORTH
CENTRAL
NORTHEAST
UPPER
DELTA
EAST
CENTRAL
LOWER
DELTA
CENTRAL
SOUTH
SOUTHWEST
SOUTHEAST
CENTRAL
COASTAL
3/26
3/31
3/31
3/26
3/31
3/21
3/16
3/11
3/11
3/16
3/21
3/26
3/26
3/21
3/21
3/16
3/11
3/16
3/11
3/6
3/1
2/24
2/19
3/11
3/6
3/1
2/24
2/19
Memphis WB AP, Tenn.
Moscow, Tenn.
Bolivar 2, Tenn.
Selmer, Tenn.
Savannah, Tenn.
Pickwick Landing Dam, Tenn.
Waterloo, Ala.
Madison, Ark.
Lake Cormorant 1 W
Pleasant Hill
Mount Pleasant
Byhalia
Holly Springs 4 N
Ashland
Corinth
Acton
Lambs Chapel School
Glens
Burnsville Substa
Hernando
Tunica
Tunica 2
Arkabutla Dam
Senatobia
Independence 3 N
Holly Springs 2 N
Ripley
Cairo
Midway
Bishop, Ala.
Hickory Flat 1 WNW
Booneville
Tishomingo 1 N
Belmont
Helena, Ark.
Sarah
Abbeville
New Albany
Baldwyn
Red Bay, Ala.
St. Charles, Ark.
Sledge
Sardis Dam
University
Batesville
Lafayette Springs
Pontotoc
Tupelo Substa
Tupelo
Fulton 3 W
Hodges, Ala.
Clarksdale
Lambert
Enid Dam
Water Valley
Sarepta 1 NNE
Pontotoc Exp Sta
Hamilton, Ala.
Vance
Charleston
Bruce
Okolona
Amory 4 W
Rosedale
Swan Lake 1 S
Coffeeville
Calhoun City
Van Vleet
Houston 2 NE
Aberdeen
Cleveland 3 N
Grenada Dam
Minter City
Holcomb
Grenada
Dancy
Vernon, Ala.
Cleveland
Arkansas City, Ark.
Elliott
West Point
Dermott, Ark.
Greenwood
Carrollton 1 SSW
Eupora
Tibbee
Columbus
Greenwood FAA AP
Moorhead
Winona 3 ENE
State University
Reform, Ala.
Vaiden 1 SSW
Ackerman
Bluff Lake
Crawford 5 WSW
Portland, Ark.
Black Hawk
Brooksville Exp Sta
Pickensville, Ala.
Belzoni
Lexington 2 NNW
Louisville
Aliceville, Ala.
Yazoo City 5 NNE
Macon 2 NE
Kosciusko
Dancy 4 N, Ala.
Rolling Fork
Ghoulson 8 W
Shuqualak
Lake Providence
Pickens
Holly Bluff
Edinburg
Philadelphia 1 WSW
Gainesville, Ala.
Carthage
Porterville
Onward
Germania
Ofahoma
Walnut Grove
Kipling
Canton
Union
Livingston, Ala.
Tallulah
Goshen Springs 2 N
Collinsville 3 NE
Decatur
Cuba, Ala.
Vicksburg WB City
Jackson WB AP
Forest
Russell 2 NNW
Pelahatchie
Newton Exp Sta
Hickory
Meridian WB AP
Clinton
Pushmataha, Ala.
Enterprise
Montrose
White Oak
Paulding
Crandall 1 N
Sylvarena 2 W
Quitman
Crystal Springs 4 NNE
Dio
Bay Springs
Heidelberg
Melvin, Ala.
Shubuta 2
Mize
Shubuta
Gilbertown, Ala.
Lorman
Rockport
Laurel
Waynesboro 3 WNW
Barlow 6 SE
Prentiss 2 NNE
Collins
Waynesboro 1 E
Brookhaven 2
Monticello 2 S
Richton
Buckatunna
Jackson Lock 1, Ala.
Meadville
Brookhaven
Chatom, Ala.
Ovett
Bude Fire Tower
Bath
Sumrall
Hattiesburg
State Line
Columbia
Richton 3 SSE
Liberty 3 E
McComb FAA
Tylertown 2 N
Beaumont
Leakesville
Woodville
Purvis
Citronelle, Ala.
Centreville 4 ESE
Brooklyn 2 SE
Merrill
Kentwood, La.
Clinton, La.
Franklinton, La.
Bogalusa, La.
Wiggins
Poplarville Exp. Station
Franklinton, La.
White Sand
Mobile WB AP, Ala.
McNeill Exp Forest
McHenry 5 ESE
La.
Saucier Exp Forest
Vancleave
Covington 4 NNW
Standard
Pearl River, La.
Picayune 4 S
Gulfport Naval Center
Pascagoula Jr High Sch
Coden, Ala.
Bay St Louis
Biloxi
Pascagoula
Fort Morgan, Ala.
Pearlington 2 NNE
STATION LEGEND
Precipitation only
Precipitation storage
Precipitation and temperature
Precipitation, temperature and evaporation
Non-recording
Both types

Figure 13. Average date last spring day with temperature of 32° or lower, 1921-1950.

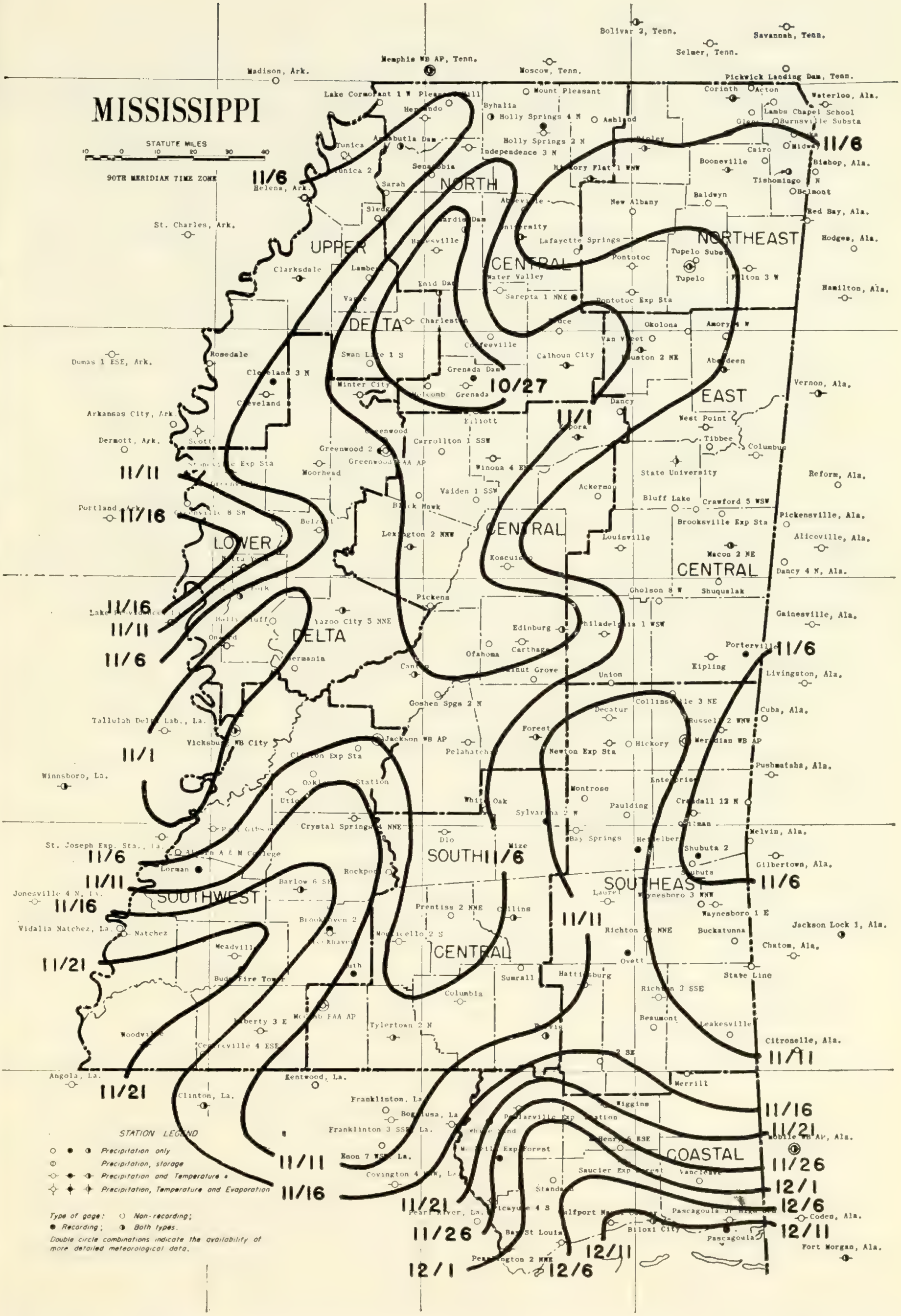

MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER DELTA
NORTH CENTRAL
NORTHEAST
EAST CENTRAL
CENTRAL
LOWER DELTA
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
COASTAL
10/27
11/1
11/6
11/11
11/16
11/21
11/26
12/1
12/6
12/11
Memphis WB AP, Tenn.
Jackson WB AP
Vicksburg WB City
Meridian WB AP
Mobile WB AP, Ala.
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording; Recording; Both types.
Double circle combinations indicate the availability of more detailed meteorological data.

**Figure 14. Average date first fall day with temperature of 32° or lower, 1921-1950.**

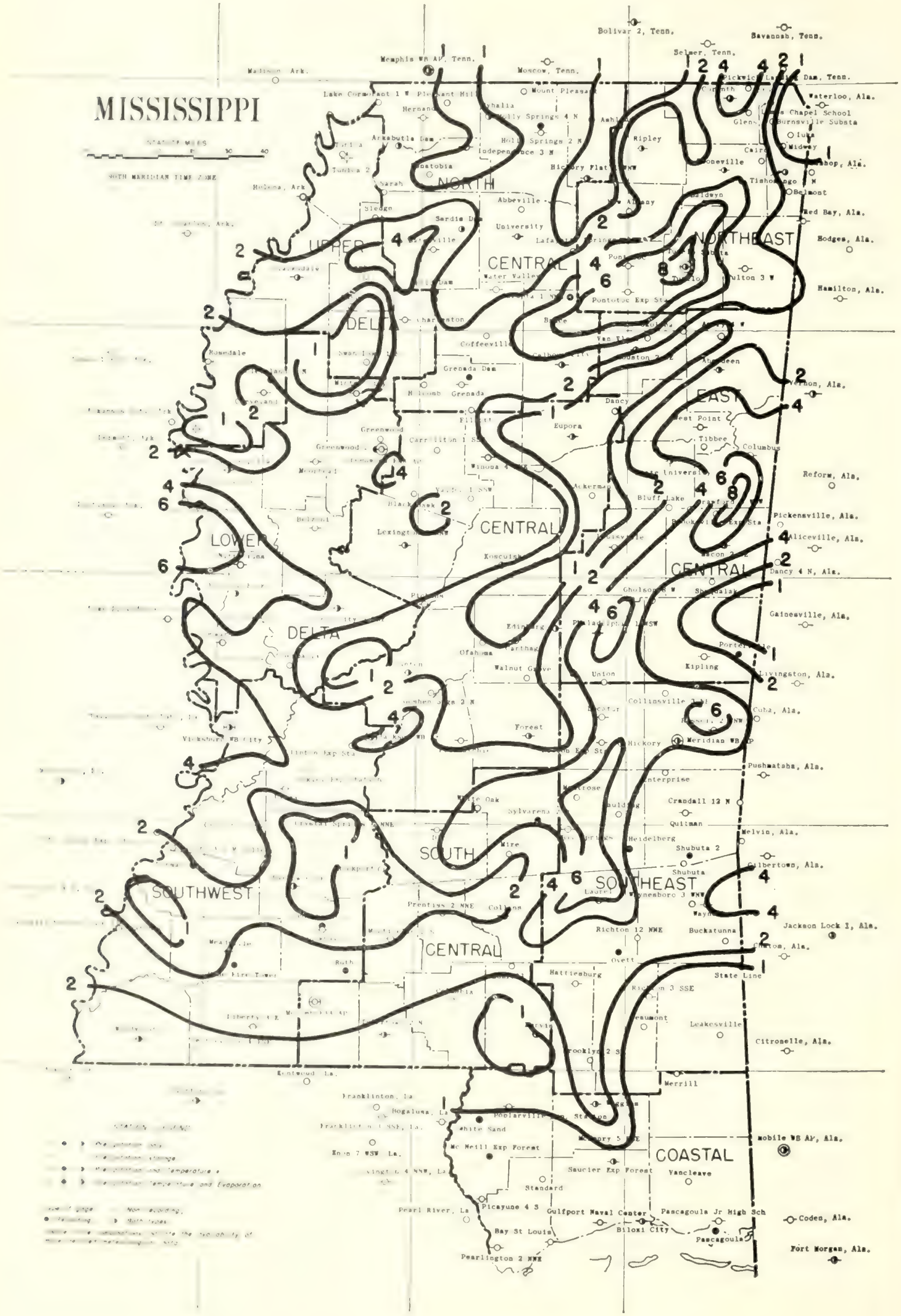
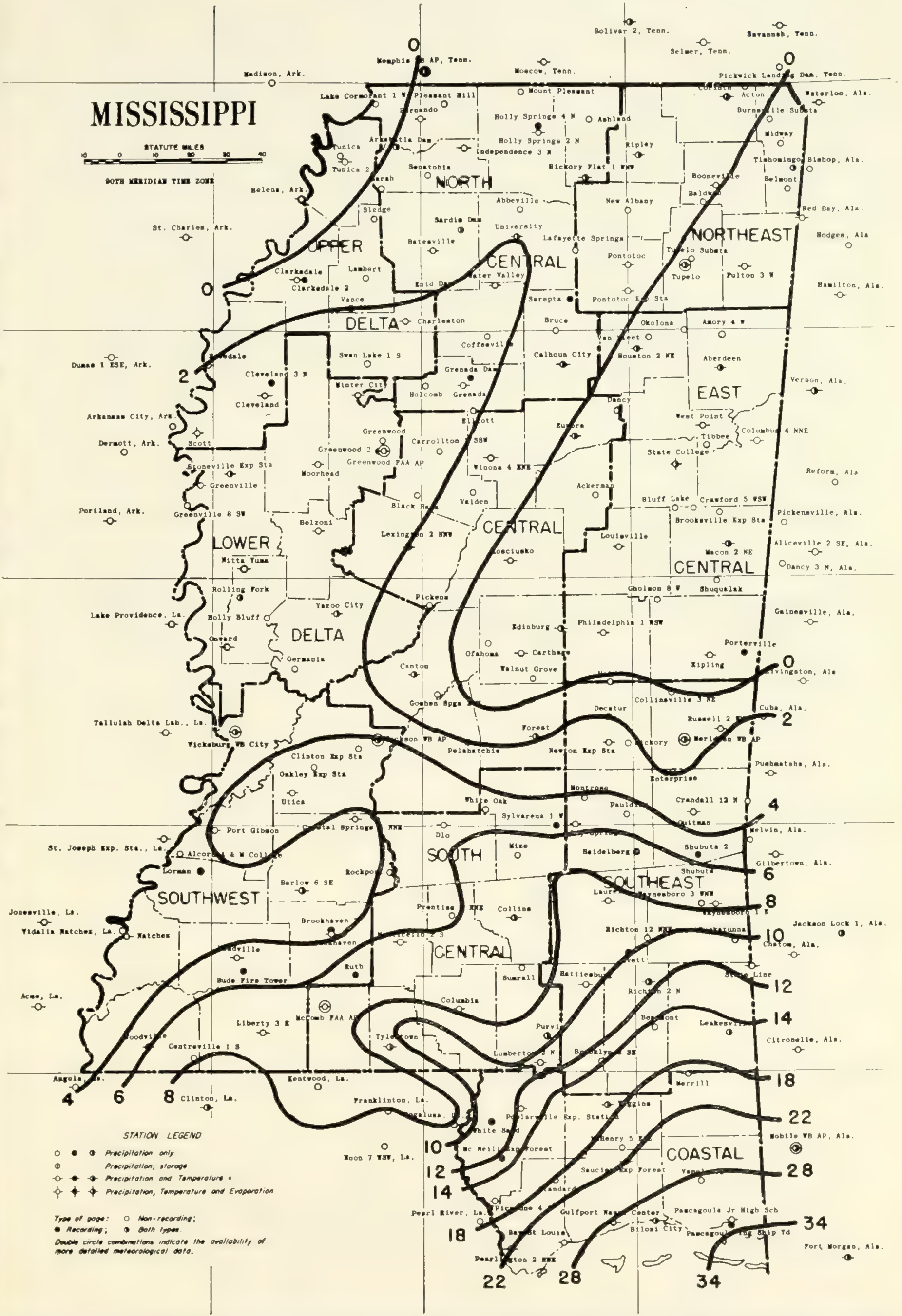

MISSISSIPPI
UPPER
DELTA
NORTH
CENTRAL
NORTHEAST
EAST
CENTRAL
CENTRAL
LOWER
DELTA
SOUTH
CENTRAL
SOUTHWEST
SOUTHEAST
COASTAL
Memphis WB AP, Tenn.
Moscow, Tenn.
Bolivar 2, Tenn.
Selmer, Tenn.
Savannah, Tenn.
Pickwick Landing Dam, Tenn.
Waterloo, Ala.
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Vernon, Ala.
Reform, Ala.
Pickensville, Ala.
Aliceville, Ala.
Dancy 4 N, Ala.
Gainesville, Ala.
Livingston, Ala.
Cuba, Ala.
Pushmataha, Ala.
Melvin, Ala.
Gilbertown, Ala.
Jackson Lock 1, Ala.
Citronelle, Ala.
Mobile WB AP, Ala.
Coden, Ala.
Fort Morgan, Ala.
Corinth
Iuka
Booneville
Ripley
Tupelo
Pontotoc
Aberdeen
West Point
Columbus
Starkville
Oxford
Holly Springs
Batesville
Clarksdale
Greenwood
Grenada
Winona
Kosciusko
Philadelphia
Meridian WB AP
Vicksburg WB City
Forest
Laurel
Hattiesburg
Waynesboro
Collins
Leakesville
Picayune
Gulfport Naval Center
Biloxi City
Pascagoula
Bay St Louis
Kentwood, La.
Franklinton, La.
Bogalusa, La.
Pearl River, La.
2
4
6
8
1

Figure 15. Number of tornadoes in 42 years.


MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
UPPER
DELTA
NORTH
CENTRAL
NORTHEAST
LOWER
DELTA
CENTRAL
EAST
CENTRAL
SOUTHWEST
SOUTH
CENTRAL
SOUTHEAST
COASTAL
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0
0
2
2
4
4
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6
8
8
10
10
12
12
14
14
18
18
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22
28
28
34
34
Memphis WB AP, Tenn.
Bolivar 2, Tenn.
Savannah, Tenn.
Selmer, Tenn.
Moscow, Tenn.
Pickwick Landing Dam, Tenn.
Madison, Ark.
Helena, Ark.
St. Charles, Ark.
Dumas 1 ESE, Ark.
Arkansas City, Ark.
Dermott, Ark.
Portland, Ark.
Lake Providence, La.
Tallulah Delta Lab., La.
St. Joseph Exp. Sta., La.
Jonesville, La.
Vidalia Natchez, La.
Acme, La.
Angola, La.
Clinton, La.
Kentwood, La.
Franklinton, La.
Bogalusa, La.
Enon 7 WSW, La.
Pearl River, La.
Waterloo, Ala.
Bishop, Ala.
Red Bay, Ala.
Hodges, Ala.
Hamilton, Ala.
Vernon, Ala.
Reform, Ala.
Pickensville, Ala.
Aliceville 2 SE, Ala.
Dancy 3 N, Ala.
Gainesville, Ala.
Livingston, Ala.
Cuba, Ala.
Pushmataha, Ala.
Melvin, Ala.
Gilbertown, Ala.
Jackson Lock 1, Ala.
Chatom, Ala.
Citronelle, Ala.
Mobile WB AP, Ala.
Fort Morgan, Ala.
Tupelo
Jackson WB AP
Vicksburg WB City
Meridian WB AP
Hattiesburg
Natchez
Greenwood
Greenville
Clarksdale
Columbus 4 NNE
State College
Biloxi City
Gulfport Naval Center
Pascagoula
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording; Recording; Both types.
Double circle combinations indicate the availability of more detailed meteorological data.

Figure 16.—Numbers of gale winds or higher during tropical storms and hurricanes in 84 years, (1875-1959). (Gale winds begin at 39 miles per hour).
]

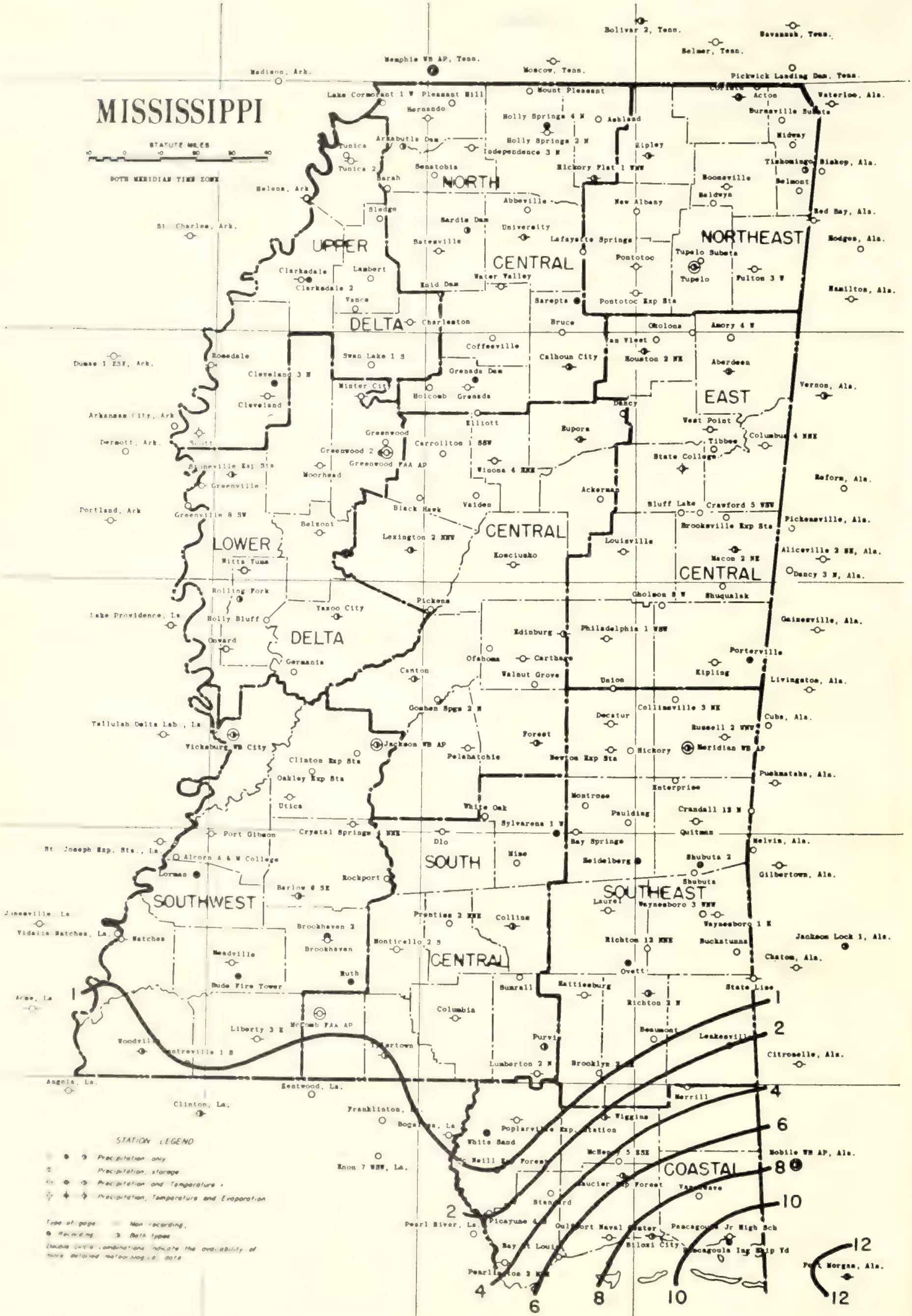
MISSISSIPPI
STATUTE MILES
90TH MERIDIAN TIME ZONE
UPPER
DELTA
NORTH
CENTRAL
NORTHEAST
LOWER
DELTA
CENTRAL
EAST
CENTRAL
SOUTHWEST
SOUTH
CENTRAL
SOUTHEAST
COASTAL
1
2
4
6
8
10
12
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage — Non recording
Recording
Both types
Double circle combinations indicate the availability of more detailed meteorological data

Figure 17.—Number of hurricane force winds during hurricanes in 84 years, 1875-1959. (Hurricane winds begin at 75 miles per hour).

BULLETIN 651 OCTOBER 1962

# Antibiotics And Stilbestrol For Cattle On High Roughage Rations

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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## CONCLUSIONS

Studies were conducted to determine the effect of antibiotics administered in salt and implanted stilbestrol in weanling and yearling cattle. One hundred ninety four animals were used in five experiments with three studies in the last experiment.

Gains of heifers or steers were not significantly affected by aureomycin, terramycin or zinc bacitracin on oat-ryegrass pasture. However, in all experiments where animals were fed high roughage rations, except experiment 3 which was self-fed ground shelled corn, there appeared to be a slight advantage in increased gain for the antibiotic fed animals. An overall consistent response to antibiotics appeared to be obtained only from aureomycin and terramycin. In this study where aureomycin or terramycin was used there appeared to be an economic benefit from the antibiotics in that for each dollar spent for antibiotics an increase in gain valued at about two dollars was returned.

In one wintering study aureomycin fed heifers gained significantly faster than controls; however, in a similar trial neither aureomycin, terramycin or zinc bacitracin significantly affected gains of heifers on a wintering ration. Gains of steers on a wintering ration were not significantly affected by aureomycin, terramycin or zinc bacitracin. The lack of statistical significance in some of the experiments can perhaps be attributed to small numbers of experimental animals.

The animals in tests 1 and 3, where the greatest response to aureomycin was obtained, were subjected to more severe winter conditions than the animals in experiments 4 and 5. From the results of these experiments it appears that administration of antibiotics may be beneficial where clinical or subclinical disease conditions may occur or exist.

Neither of three antibiotics improved weight gains of steers receiving corn on oat-ryegrass pasture over the controls. Stilbestrol did not significantly affect weight gains of heifers in a wintering study, but significantly improved gains of steers on oat-ryegrass pasture plus corn and significantly improved gains of other steers on wintering rations. Stilbestrol improved weight gains of steers in another trial on oat-ryegrass pasture plus corn at a highly significant rate.

Antibiotics were successfully administered in salt at a constant rate.

# ANTIBIOTICS AND STILBESTROL FOR CATTLE ON HIGH ROUGHAGE RATIONS

By J. N. WILLIAMS, II And H. W. ESSIG

Beef cattle on high roughage rations have usually shown the greatest response to antibiotics (6) (8). In many experiments, the antibiotics have been administered in the feed, but in recent work they have been given in the salt (1) (9). The favorable effect of the synthetic female hormone stilbestrol (DES) on the growth rate of cattle has been demonstrated by many workers (3) (5) (7).

The experiments reported herein were conducted to determine: (1) if certain antibiotics would provide more economic production of beef cattle on high roughage rations; (2) if antibiotics could be successfully administered in the salt at a relatively constant rate; (3) the effect of antibiotics in the growth of beef animals receiving grain while on pasture; and (4) the effect of the use of subcutaneously implanted stilbestrol with antibiotics.

### Experimental Procedure

One hundred ninety-four animals were involved in five experiments with three phases in the last experiment. Loose salt was provided free-choice in sheltered boxes for all animals on test. Antibiotics were mixed with the salt at twice weekly intervals to provide 70 milligrams of antibiotic per head daily to treated animals in the first and third experiments. Seventy-five mg. of antibiotic per head daily was provided in the same manner to treated animals in all other experiments. The experiments were as follows:

Experiment 1 Aureomycin in salt and implanted stilbestrol for heifers on oat-ryegrass pasture.

Experiment 2 Aureomycin in salt for heifers on a wintering ration.

Experiment 3 Aureomycin in salt and four levels of implanted stilbestrol for steers receiving ground shelled corn on oat-ryegrass pasture.

Experiment 4 Aureomycin, terramycin, and zinc bacitracin in salt for heifers on a wintering ration.

Experiment 5 Aureomycin, terramycin and zinc bacitracin in salt for steers:

Phase A, on oat-ryegrass pasture.

Phase B, on a wintering ration.

Phase C, on pasture with a full feed of ground ear corn.

**Experiment 1.** Twenty-eight yearling heifers were divided into two groups and each group was placed on a 10-acre oat-ryegrass pasture for 61 days starting March 30, 1960. One group received 70 mg. aureomycin per head daily and the other heifers received no aureomycin. Seven in each lot were subcutaneously implanted with 24 mg. of stilbestrol 132 days before the beginning of the trial.

Results of this experiment are shown in Table 1. Gains of heifers receiving aureomycin were greater than those not receiving the antibiotic. However, the differ-

**Table 1.—Effect of aureomycin administered in salt and stilbestrol implants for heifers on oat-ryegrass pasture for 61 days.**

| | Antibiotic | | | No antibiotic | | |
|---|---|---|---|---|---|---|
| Treatments | No DES | DES | Av. | No DES | DES | Av. |
| Heifers per treatment | 7 | 7 | 14 | 7 | 7 | 14 |
| Av. init. wt. (lb.) | 537.3 | 561.3 | 549.3 | 533.1 | 567.1 | 550.1 |
| Av. final wt. (lb.) | 661.0 | 687.3 | 674.4 | 633.4 | 687.3 | 660.4 |
| Av. total gain (lb.) | 123.7 | 126.5 | 125.1 | 100.3 | 120.2 | 110.3 |
| Av. daily gain (lb.) | 2.03 | 2.08 | 2.05 | 1.64 | 1.97 | 1.81 |
| Aureomycin (mg. per head daily) | 70 | 70 | 70 | ——— | ——— | ——— |
| DES* (mg.) | ——— | 24 | ——— | ——— | 24 | ——— |
| Av. daily salt consumption** (gm.) | ——— | ——— | 35.9 | ——— | ——— | 35.4 |

*DES - Stilbestrol (diethylstilbestrol).

**Salt consumption records were kept only on antibiotic and no antibiotic treatments.

ence due to aureomycin was not as great with the animals receiving stilbestrol as with those not receiving the hormone. Animals implanted with stilbestrol with and without aureomycin gained more than those not receiving stilbestrol. Animals receiving aureomycin gained an average of 2.05 lb. per head daily while the controls gained 1.81 lb. per head daily. There were no significant differences in rate of gain due to treatments.

**Experiment 2.** Fifty yearling heifers were divided into two groups of 25 each, weighed and placed on a wintering ration in drylot for 81 days beginning January 15, 1960. The group in treatment 1 received no aureomycin, while heifers in treatment 2 were given 75 mg. aureomyin per head daily in loose salt. The wintering ration given these animals consisted of approximately 20 lb. sorghum silage, 1.5 lb. cottonseed meal and 2 lb. ground shelled corn per head daily throughout the experiment.

Results of this 81-day wintering trial are reported in Table 2. Heifers receiving 75 mg. of aureomycin per head daily gained faster than the controls. The difference in rate of gain of the two groups was tested by the analysis of variance and found to be highly significant.

**Experiment 3.** During the spring of 1960, a group of 40 yearling steers were randomly assigned to two treatments of 20 steers each, weighed and placed on two 12.5 acre pastures. The experiment began April 2, 1960 and continued 56 days. All steers received a full feed of ground shelled corn. Animals in treatment 1 received 70 mg. of aureomycin per head daily in loose salt, while those in treatment 2 received no antibiotic. Each of the two treatment groups involved four sub-groups of five steers each which received the following levels of stilbestrol as implants: none; 12 mg.; 24 mg.; and 36 mg. The pasture consisted of an oat-ryegrass mixture, and the two groups of steers were exchanged between pastures each two weeks to eliminate any differences that might exist between the pastures.

Steers receiving aureomycin made an average daily gain of 2.00 pounds while those receiving no aureomycin gained 2.04 lb. per head daily (Table 3). One steer receiving aureomycin gained only 0.25 lb. daily and this could easily account for the slightly lower gain of the antibiotic steers. There was no significant difference for average between the two levels of antibiotics. The stilbestrol implanted steers at all levels significantly

**Table 2. Effect of aureomycin administered in salt for heifers on a wintering ration for 81 days.**

| Treatments | 1 | 2 |
|---|---|---|
| Heifers per treatment | 25 | 23* |
| Av. initial wt. (lb.) | 438.7 | 414.7 |
| Av. final wt. (lb.) | 486.7 | 492.3 |
| Av. total gain (lb.) | 47.5 | 77.6 |
| Av. daily gain (lb.) | 0.59 | 0.96** |
| Aureomycin (mg. per heifer daily) | — | |
| Av. daily salt consumption (gm.) | 41.2 | 58.7 |

*Two animals died in this treatment group. **Highly significant (P0.O1).

**Table 3.—Effect of aureomycin administered in salt with four levels of stilbestrol implanted for steers receiving ground shelled corn on pastures — 56 days.**

| Treatments | 1 | 2 |
|---|---|---|
| Steers per treatment | 20 | 20 |
| Av. initial wt. (lb.) | 544.7 | 572.7 |
| Av. final wt. (lb.) | 656.5 | 689.7 |
| Av. total gain (lb.) | 111.8 | 114.7 |
| Av. daily gain (lb.) | 2.00 | 2.04 |
| Aureomycin (mg. per steer daily) | 70 | — |
| Av. daily salt consumed (gm.) | 16.2 | 18.4 |

**Table 4.—Effect of four levels of stilbestrol implants across two levels of aureomycin in experiment 3.**

| Treatments | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Stilbestrol, mg. | 0 | 12 | 24 | 36 |
| No. of steers | 10 | 10 | 10 | 10 |
| Av. initial wt., lb. | 574.7 | 563.0 | 543.5 | 553.5 |
| Av. final wt., lb. | 659.5 | 684.4 | 662.4 | 680.0 |
| Av. total gain, lb. | 84.8 | 121.4 | 118.9 | 126.5 |
| Av. daily gain, lb. | 1.51* | 2.17 | 2.12 | 2.26 |

*Significant (P0.05)

**Table 5.—Effect of aureomycin, terramycin, and zinc bacitracin administered in the salt to heifers on a wintering ration for 111 days.**

| Treatments | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Heifers per treatment | 12 | 12 | 12 | 12 |
| Av. initial wt. (lb.) | 422.0 | 436.8 | 435.5 | 521.7 |
| Av. final wt. (lb.) | 539.8 | 562.7 | 561.8 | 533.5 |
| Av. total gain (lb.) | 117.8 | 125.9 | 126.3 | 111.8 |
| Av. daily gain (lb.) | 1.06 | 1.13 | 1.14 | 1.01 |
| Antibiotics (mg. per head daily) | | | | |
| Aureomycin | — | 75 | — | — |
| Terramycin | — | — | 75 | — |
| Zinc bactracin | — | — | — | 75 |
| Av. daily salt consumption (gm.) | 21.9 | 18.3 | 19.2 | 30.3 |
| Av. daily feed consumption (lb.) | | | | |
| Silage | 22.2 | 26.2 | 25.7 | 22.7 |
| Cottonseed meal | 1.47 | 1.47 | 1.47 | 1.47 |
| Ground shelled corn | 1.96 | 1.96 | 1.96 | 1.96 |
| Total | 25.63 | 29.63 | 29.13 | 26.13 |

outgained the non-implanted controls (Table 4). There was no difference within the three levels of stilbestrol administration.

**Experiment 4.** A group of 48 Hereford and Angus heifers were placed on a wintering study in drylot which lasted 111 days. Animals were randomly allotted to four groups of 12 heifers each. Treatments provided the following levels per head daily of antibiotics: None; 75 mg. aureomycin; 75 mg. terramycin, and 75 mg. zinc bacitracin. Animals were fed a ration consisting of 2 lb. ground shelled corn and 1.5 lb. cottonseed meal per head daily plus a full feed of sorghum silage.

Results of the administration of antibiotics to heifers in this series of trials (Table 5) agree with the results of Experiment 1 and Experiment 3, inasmuch as there were no significant differences in the antibiotic treatments. These results agree with those of other workers (4) (1). However, in this experiment, the use of aureomycin and terramycin (but not zinc bacitracin) was economically beneficial as the returns for the use of these antibiotics were approximately two dollars for each dollar value of antibiotic used. No difficulty was experienced in obtaining a constant rate of antibiotic intake with any group during this experiment.

The amount of concentrates was kept constant in this experiment, but the silage was fed ad libitum. Examination of Table 5 shows that all antibiotic-fed heifers consumed more feed per head daily than the controls. This, too, agrees with other findings (2).

The general health of the animals in all treatments was very good during this wintering study. The winter was reasonably mild. This could account for the low response to antibiotics as compared to Experiment 2 when the winter was more severe.

**Experiment 5.** Since the gains of antibiotic treatment groups (Experiment 3 and 4) were not significantly different from gains of controls it was apparent that studies were needed to determine if these increased gains over controls were consistent in repeated experiments. This experiment was designed to study the effect of three antibiotics and stilbestrol on weanling steers receiving high roughage rations during three phases which differed in: (1) period of time, and (2) feeding regimen. Twenty-eight steers were randomly assigned to four treatments of seven animals each and received the following treatments: (1) no antibiotic; (2) 75 mg. aureomycin per head daily; (3) 75 mg. terramycin per head daily, and (4) 75 mg. zinc bacitracin per head daily. Four steers in each group were subcutaneously implanted with 12mg. of stilbestrol at the beginning of the experiment and three animals in each group received no stilbestrol. The steers were kept in the same treatment groups throughout the experiment. The grazing paddocks consisted of an oat-ryegrass mixture, and the four treatment groups were exchanged between pastures each two weeks to minimize differences that might exist between the pastures. The three phases of the experiment were as follows:

**Phase A.** The steers in each treatment group during this 84-day period beginning October 24, 1960 were allowed to graze five-acre paddocks of oat-ryegrass pasture.

**Phase B.** The four treatment groups were placed in four drylots for a 39-day wintering period beginning January 16, 1961. The ration was the same as that for heifers in Experiment 4.

**Phase C.** Treatment groups were again placed on the grazing paddocks February 24, 1961 and full fed ground snapped corn for 87 days. On April 7, 1961, steers in each lot that had previously received stilbestrol were again implanted with 12 mg. of stilbestrol per head.

**Results Experiment 5. Phase A.** Results of this 84-day pasture phase are presented in Tables 6 and 7. There were no significant differences among antibiotic treatments and controls. Stilbestrol treated animals gained an average of 2.25 lb. per head daily compared to 1.92 lb. per head daily for those not receiving stilbestrol. These differences were highly significant.

**Phase B.** The antibiotic treatments in this 39-day wintering phase did not significantly affect the rate of gain of steers.

Table 6.—**Effect of chlortetracycline, oxytetracycline and zinc bacitracin administered in the salt for steers on oat-ryegrass pastures for 84 days.**

| Treatments | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Steers per treatment | 7 | 7 | 7 | 7 |
| Av. initial wt. (lb.) | 428.8 | 441.6 | 387.6 | 411.8 |
| Av. final wt. (lb.) | 599.4 | 618.3 | 577.6 | 582.8 |
| Av. total gain (lb.) | 169.6 | 176.7 | 190.0 | 171.0 |
| Av. daily gain (lb.) | 2.02 | 2.10 | 2.26 | 2.04 |
| Antibiotic (mg. per head daily) | | | | |
| Aureomycin | — | 75 | — | — |
| Terramycin | — | — | 75 | — |
| Zinc bacitracin | — | — | — | 75 |
| Av. daily salt consumption (gm.) | 24.2 | 24.5 | 17.7 | 23.4 |

Table 7.—**Effect of subcutaneously implanted diethylstilbestrol over all antibotic treatments in phase A — experiment 5.**

| Treatments | 1 | 2 |
|---|---|---|
| Steers per treatment | 16 | 12 |
| Av. initial wt. (lb.) | 421.4 | 412.8 |
| Av. final wt. (lb.) | 610.1 | 573.7 |
| Av. total gain (lb.) | 188.7 | 160.9 |
| Av. daily gain (lb.) | 2.25** | 1.92 |
| Diethylstilbestrol (mg.) | 12 | 0 |

**Highly significant (P0.01)

**Table 8.—Effect of aureomycin, terramycin and zinc bacitracin in the salt for steers on wintering rations on two levels of stilbestrol for 39 days.**

| Treatments | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Antibiotic (mg. per head daily) | | | | |
| Aureomycin | — | 75 | — | — |
| Terramycin | — | — | 75 | — |
| Zinc bactracin | — | — | — | 75 |
| Steers per treatment | 7 | 7 | 7 | 7 |
| Av. daily gain (lb.) | 0.94 | 1.12 | 0.86 | 0.71 |
| DES* (mg.) | 0 | 0 | 0 | 0 |
| Steers per treatment | 3 | 3 | 3 | 3 |
| Av. daily gain (lb.) | 0.94 | 1.28 | 0.33 | 0.17 |
| Des (mg.) | 12 | 12 | 12 | 12 |
| Steers per treatment | 4 | 4 | 4 | 4 |
| Av. daily gain (lb.) | 0.95 | 1.00 | 1.25 | 1.11 |
| Feed per 100 lb. gain (lb.) | 3570 | 2696 | 3661 | 3762 |
| Salt consumption per head daily (gm.) | 57.8 | 55.6 | 49.3 | 45.5 |

*DES — Stilbestrol

**Table 9.—Effect of aureomycin, terramycin and zinc bacitracin in the salt for steers fed corn on pastures and on two levels of stilbestrol for 87 days.**

| Treatments | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Antibiotic (mg. per head daily) | | | | |
| Aureomycin | — | 75 | — | — |
| Terramycin | — | — | 75 | — |
| Zinc bacitracin | — | — | — | 75 |
| Steers per treatment | 7 | 7 | 7 | 7 |
| Av. daily gain (lb.) | 2.10 | 2.23 | 2.17 | 2.16 |
| DES* (mg.) | 0 | 0 | 0 | 0 |
| Steers per treatment | 3 | 3 | 3 | 3 |
| Av. daily gain (lb.) | 1.75 | 2.15 | 2.40 | 2.09 |
| DES (mg.) | 24 | 24 | 24 | 24 |
| Steers per treatment | 4 | 4 | 4 | 4 |
| Av. daily gain (lb.) | 2.36 | 2.30 | 1.99 | 2.22 |
| Salt consumption per head daily (gm.) | 20.2 | 17.4 | 14.4 | 15.6 |

*DES — Stilbestrol

However, stilbestrol treatments resulted in a significant increase in weight gains, and the interaction between stilbestrol and antibiotics was significant. This significant interaction was caused by the increased gain for the non-implanted steers which received aureomycin, whereas in all other treatments those animals which received stilbestrol outgained those which did not receive stilbestrol A possible explanation for this inconsistency in gain was the small number of animals and the extremely short period of time that this phase of the study was conducted The results are given in Table 8.

**Phase C.** In this study when steers were receiving corn on pasture for 87 days, neither antibiotics nor stilbestrol treatments resulted in significantly different gains. However, the interaction between antibiotics and stilbestrol was highly significant according to the analysis of variance, which means that there was inconsistency in the results of the various treatments. Steers receiving terramycin and implanted gained less than any of the steers on the other stilbestrol treatments. A possible explanation for this inconsistency is the small number of animals per treatment. Results of this phase are shown in Table 9.

**Summary of Experiment 5.** The results of treatments administered to 28 steers over the entire 210-day experiment are summarized in Tables 10 and 11.

Steers receiving stilbestrol gained 2.02 lb. per head daily compared to a daily mean gain of 1.76 lb. for steers not receiving stilbestrol. Neither the antibiotic treatments nor the interaction between antibiotics and stilbestrol were significant. However, the rate of gain of the animals which received the aureomycin and terramycin treatments resulted in a slight increase over the controls and zinc bacitracin. Slaughter grades were not significantly affected by any of the treatments. Health of the animals was generally good throughout the experiment.

Salt consumption among treatments was not greatly different. No difficulty was experienced in adjusting for salt consumption at biweekly intervals. The antibiotic intake by each group of animals was uniform throughout the experiment.

**Table 10.—Results of experiment 5 — all phases.**

| Treatments | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Steers per treatment | 7 | 7 | 7 | 7 |
| Av. initial wt. (lb.) | 429.8 | 441.6 | 387.6 | 411.8 |
| Av. final wt. (lb.) | 819.1 | 856.6 | 799.6 | 798.7 |
| Av. total gain (lb.) | 389.3 | 415.0 | 412.0 | 386.9 |
| Av. daily gain (lb.) | 1.85 | 1.98 | 1.96 | 1.84 |
| Antibiotic (mg. per head daily) | | | | |
| Aureomycin | — | 75 | — | — |
| Terramycin | — | — | 75 | — |
| Zinc bacitracin | — | — | — | 75 |
| Av. daily salt consumption (gm.) | 28.8 | 27.3 | 22.2 | 24.3 |
| Av. slaughter grade* | 9.07 | 9.29 | 8.93 | 9.07 |

*Code: 8 — High Standard; 9 — Low Good; 10 — Medium Good.

**Table 11.—Results of stilbestrol treatments in experiment 5 — all phases.**

| Treatments | 1 | 2 |
|---|---|---|
| Stilbestrol (mg.) | 24 | 0 |
| Steers per treatment | 16 | 12 |
| Av. initial wt. (lb.) | 421.4 | 412.8 |
| Av. final wt. (lb.) | 845.4 | 782.7 |
| Av. total gain (lb.) | 424.0 | 369.9 |
| Av. daily gain (lb.) | 2.02** | 1.76 |
| Av. slaughter grade* | 9.22 | 8.92 |

*Code: 8 — High Standard; 9 — Low Good; 10 — Medium Good.
**Highly significant (P0.01)

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## Industrialization in Chickasaw County, Mississippi:

# A Study Of Rural Residents

By

GEORGE L. WILBER

and

SHERIDAN T. MAITLAND

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## SUMMARY

This study is one of a series attempting to find out what happens in a low-income rural community when a new industrial plant moves in. Evidence was obtained from two sets of interviews, with workers in a furniture factory and with a sample of household heads in the open-country area around the community of Houston, Mississippi. In this report attention is focused on comparisons of open-country folks and plant workers. Specifically, an attempt is made to shed light on (1) the nature of the process of selection of rural people for industrial employment, (2) the influence of a new factory on socio-economic status and levels of living, (3) certain influences of industrial employment on farmers and farm operation, (4) changes in social participation, and (5) effects of the new factory on opinions about the community.

Young white, males with better than average education who were married and rearing a family made up the largest part of the plant work force. Since all plant workers were white and all but one was under 50 years of age, most of the comparisons between plant workers and open-country residents are restricted to the "young" whites.

Because of the predominance of young males, plant workers also tended to be either single persons or heads of newly formed families. Factory workers also had more schooling than their open-country counterparts.

Plant workers showed a greater tendency to change jobs and residences than the average rural household head in the community.

All of the evidence here points strongly to processes of selection in industrial employment. While this means that many open-country residents are unlikely to be employed in industry because of their age, sex, color, education, and so on, it also means that the type of person most likely to migrate to another area in search of a job—the young man—is provided with industrial employment at home. Plant workers received higher incomes than the open-country people, but this difference is explained in part by the contrasts in age and color of the two groups. White open-country heads of households under 35 years of age had incomes comparable to those of the plant workers. Differences in socio-economic status and levels of living also tended to disappear as other differences are accounted for. Open-country residents of the community had improved their level of living at a lesser rate than the plant workers in the period since the plant opened.

There were 27 part-time farmers. The part-time farmer was typically younger than the full-time farmer. Full-time farmers more commonly operated commercial types farms. Farmers whether they work at the factory or not, were a generally stable residential group, a majority having operated a farm for at least 10 years.

Social participation, measured by the number of formal group memberships, was essentially the same for plant workers and for open-country household heads. Nonfarm residents were slightly less inclined toward membership than those living on farms in both the open-country sample and the plant worker group. The stage in the life cycle of the family had little connection with social participation of open-country folks, but among plant workers those with children ranging from pre-school to post-school ages showed a tendency to report no organizational membership. Higher income was more conducive to social participation among plant workers than it was among open-country people.

Respondents generally felt that various community institutions had improved since the furniture factory had opened, with plant workers more favorable in their reactions. Both plant workers and open-country whites aged 35 to 49 years more often said that schools had improved than either younger or older persons.

# Industrialization in Chickasaw County, Mississippi: A Study of Rural Residents

By GEORGE L. WILBER and SHERIDAN T. MAITLAND

## INTRODUCTION

Many rural communities of the South have become increasingly aware of the significance of industrial opportunities as industry has continued to develop throughout the region. Industrialization brings with it employment, income and a chance to broaden and strengthen the economy from within the local community. In addition, industrial development in a rural area is likely to bring various other changes — departures from agriculture, urban growth, increased employment of workers and so on. It is with some of these changes that take place as a new industrial plant is established in a community that this study is concerned. Findings in an earlier report were concerned primarily with the effects on rural area residents who had taken jobs in a new factory, especially the influence on levels of living, scale of farming operations, participation in community affairs and attitudes toward the community.[1] In this report attention is focused on rural area residents—including a few who took jobs in the new factory—primarily to determine the selective nature of such employment and its effect on levels of living, socio-economic status, social participation and attitudes toward the community.

### Need for the Study

It is generally conceded that industrialization is beneficial in providing employment and income to local residents, but relatively little is known at this point about the effects of industrialization on attitudes and behavior patterns. What happens to people's attitudes toward their community, its churches and schools? Do they participate in different groups or to a different extent? Are workers employed in the new industry typical of people in the community or do they represent a special group? Do workers recruited from farms continue farming on a part-time basis? These are some of the questions on which it is hoped the present study will supply information. Other rural communities, faced with a similar experience of industrial development may benefit from such information.

For many decades there has been a general exodus of people from farms and from the State.[2] The number of persons living on farms has declined drastically for the last 20 years. While Mississippi's population has remained relatively stable for several decades, fluctuating around the two million mark, about 40,000 persons are lost each year as a result of migration from the state. High levels of industrial employment around the country combined with under-employment on farms have encouraged these movements from farms and from the State. The State of Mississippi has conducted a program for over two decades designed to encourage industrial development (Balance Agriculture With Industry). At-

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*From the Department of Sociology and Rural Life, Mississippi State University and formerly the Economic Research Service, United States Department of Agriculture, respectively.

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[1] Sheridan T. Maitland and George L. Wilber, **Industrialization in Chickasaw County, Mississippi: A Study of Plant Workers.** Bulletin 566 (Mississippi Agricultural Experiment Station, 1958).

[2] Cf. H. A. Pedersen, **Migration from Mississippi.** State College, Mississippi Agricultural Experiment Station Information Sheet, No. 536, May 1956; and E. S. Bryant and G. L. Wilber, **Net Migration in Mississippi, 1950 to 1960** Bulletin 632, Mississippi Agricultural Experiment Station, December 1961.

tempts to encourage new industry have had remarkable success, but in 1950 only 13 percent of those employed in Mississippi were engaged in manufacturing (the comparable figure for the U.S. was 26 percent).

The State's program to attract new industry was augmented in 1954, when the United States Department of Agriculture initiated the Rural Development Program. This effort was strengthened and broadened through the creation of the Rural Areas Development Office in the Department of Agriculture to co-ordinate the Department's responsibilities under the Area Redevelopment Act of 1961. One of the objectives of this program is to help State and local programs in their efforts to raise rural incomes by encouraging location of industrial plants in rural areas. It is felt that industrial employment will strengthen the economic foundations of the community and provide jobs for local residents who would otherwise seek employment elsewhere.

## Objectives of the Study

The most general objective of this study is to find out what happens in a low-income rural community when a new industry is established. As a focus for the following discussion, these specific objectives have been set.

1. Examine some of the characteristics of workers recruited for industrial employment in comparison with those of rural residents in an effort to determine whether there is any selection of certain types of persons for industrial employment.

2. Assess the influence of industrial employment on socio-economic status, income and level of living by comparing factory workers with other rural residents.

3. Explore effects of industrialization on farmers, especially the influence of industrial employment on tenure, mobility, social participation and socio-economic status.

4. Seek to discover what changes, if any, have occurred in social participation as a result of industrial employment.

5. Determine whether a new factory may influence attitudes toward community organizations and institutions.

## The Sample and Interviews

Chickasaw County, in northeast Mississippi, was selected as the survey area. Although a number of rural communities in Mississippi had some of the characteristics sought, the area chosen came closest to approximating the conditions set forth for this study of the impact of industrialization on a rural community. The county was predominantly rural, with almost two-thirds of its residents classed as rural farm in 1950. Median family income for 1949 was $999, about $200 less than the average for the state and $2,000 less than the national average. Most important was the fact that a new factory had recently located in Houston, the county seat, and it was anticipated that the social and economic effects of this new industry would be important in the community. The Jackson Manufacturing Company, a furniture factory, established in 1954 employed about 130 persons at the time of the survey.

Interview schedules were prepared to obtain pertinent information on personal and family characteristics, work experience, income, level of living, social participation, farm operations and attitudes toward the factory and the community. A basic family schedule was administered to all respondents, and supplementary schedules were used for farm residents, former farm residents and for nonfarm workers. Two groups of respondents were chosen for the survey: (1) all the workers on the hourly payroll of the furniture factory, and (2) a sample of rural household heads living in the area surrounding Houston and representing the residents of the western two-thirds of Chickasaw County.

**Table 1.—Major components of the samples Chickasaw County, 1957.**

| | Plant sample[1] | Open-country sample[2] |
|---|---|---|
| Respondents | 106 | 317 |
| Household heads | 79 | 317 |
| Adult family members | 273 | 781 |
| Furniture plant workers | 106 | 9 |
| All other nonfarm workers | | 161 |
| Wage and salary | — | 88 |
| Self-employed | — | 18 |
| Not reported | — | 55 |
| Farm operators | 27 | 202 |
| Farm wage workers | — | 2 |

[1] Includes nine furniture plant workers who also were selected in the open-counrty sample.
[2] Includes nine open-country residents who also were employees of the furniture plant.

Altogether, 414 persons were interviewed, 106 worked in the furniture factory and 308 heads of rural households. Nine of the plant workers also were rural residents drawn in the rural sample, so the total number of rural households was 317. Interviews were conducted over a period of about two weeks in the Spring of 1957. Major segments of the samples are shown in Table 1.

## The Study Area

Chickasaw County is located in north central Mississippi on the edge of the Black Prairie. Agriculture in the area has developed from the old plantation economy to mixed cotton, dairy and cattle production. Farms are generally of modest size, averaging 130 acres in 1959. There has been a slight tendency in recent years for farmers to engage in off-farm work, and fewer farmers now live on the farm which they operate. The number of farm operators decreased by 37 percent from 1950 to 1959 (including a 5 percent loss due to change in definition) the greatest decline being among tenant farmers where the drop was 60 percent. More than half of the farm operators in 1959 were white. Farm land including buildings were valued at $83 per acre in the 1959 Census of Agriculture.

Chickasaw County's population declined during the 1950's by 11 percent to 16,891 in 1960. Net migration losses for the decade ran an estimated 5,000 persons, or more than enough to offset the natural increase of population in the county. Median age in the county was 25.8 years in 1960, and the aging of the population is reflected in the increase in persons 65 years of age and over—up to 11 percent of the population in 1960 as compared with 8 percent in 1950.

Nearly 4,000, or over 70 percent, of the males 14 years of age and over were in the labor force in 1960. Employed men had a median income of $1,422 in 1959, as compared to a median family income of $2,484. About 1 in 4 employed persons were in agriculture and an equal number in manufacturing industries. Men who were farmers had a median cash income in 1959 of only $842, while craftsmen averaged $2,862, operatives $2,062, and laborers $1,137.

Houston, the site of the furniture factory, grew by 55 percent during the decade to reach a population of 2,577 by 1960. Three-fourths of the city's population was white. Not only had the city's residents completed more schooling than for the county as a whole, but median family income was higher ($3,827). Employment was concentrated mainly in manufacturing, trade and services.

## SELECTIVITY FOR INDUSTRIAL EMPLOYMENT

On the assumption that recruitment for industrial employment in a rural community will be selective — that is, some persons are more likely to be employed than others — the immediate objective in this section is to point out some of the characteristics on which plant employees differ from other residents in the community. Specifically, such things as age, sex, race, martial status, family stage, education, and employment and residential mobility are considered to be part of the more general selective processes. With the evidence in this study alone, it is impossible to determine how generalized the various criteria of selectivity may be. Nevertheless, one may expect to find essentially the same selective factors at work in other low-income rural areas.

### Age, Sex and Race

In general, industrial hiring practices place a high premium on manual dexterity, stamina, and mechanical skills. When a new plant is opened, experience and skill specifications may need to be lowered in order that the plant work force can be obtained and production started in a reasonable length of time. The most accessible and readily employable part of the labor force are the younger males. Hence, workers tend to be recruited from among younger males who have had previous industrial experience.

In this study young adult white males predominate among the plant workers. Although 29 percent of the rural area household heads were nonwhite, none were employed in the furniture factory. Only about one in fifteen of the nonwhites in the rural area sample had nonfarm employment, indicating that industrial employment in this county was largely confined to the white population. For this reason most of the comparisons throughout this report are made between the plant workers and the white heads of households in the rural area sample.

Employees in the furniture factory were younger than their open-country counterparts by about 26 years. Plant workers averaged 28 years of age and white open-country household heads 54 years, as shown in Table 2. With three in five open-country respondents at least

Table 2.—Age Distribution of Plant Workers and Open-country Household Heads, by Color.

| Age | Plant workers | Open-country household heads | | |
|---|---|---|---|---|
| | | Total | White | Nonwhite |
| | (106)* | (317)* | (224)* | (93)* |
| | | | Percent | |
| All cases | 100 | 100 | 100 | 100 |
| Under 25 | 38 | 4 | 5 | 2 |
| 25-29 | 16 | 6 | 5 | 10 |
| 30-34 | 22 | 8 | 9 | 5 |
| 35-39 | 13 | 7 | 7 | 6 |
| 40-44 | 6 | 10 | 9 | 13 |
| 45-49 | 4 | 9 | 6 | 15 |
| 50-54 | — | 12 | 11 | 13 |
| 55-64 | 1 | 18 | 19 | 14 |
| 65 & over | — | 26 | 29 | 22 |
| Median age: | 28 | 52 | 54 | 50 |

*Figures in parentheses in this and following tables show the number of respondents upon which percentages were calculated. Base figures vary from table to table due to variations in completeness of responses as well as to differences in the content of tables.

Differences in this and all subsequent tables are tatistically significant at the .05 level unless otherwise indicated.

fifty years of age and a majority of the plant workers under 30 years, there is not only a high degree of age selectivity in industrial recruitment but many residents of the area would seem to be disqualified for industrial employment by virtue of age alone.

Males were represented in approximately the same proportions among plant workers and white household heads in the rural sample. A large majority of plant workers were men, 84 percent, as were white household heads, 90 percent. Because the area sample was limited to household heads, it is not possible to determine the extent of sex selectivity among plant workers. However, because the distribution of men and women in the two groups is so similar, other contrasts to be noted are not materially affected by sex differences.

### Marital Status and Family Stage

The relatively high proportion of unmarried persons employed in the plant is largely a function of age. With nearly 40 percent of the plant workers under 25 years of age, it is not too surprising that about one out of five workers were single. The higher proportion of widowed persons in the rural sample is also a reflection of the age distribution (see Table 3).

Age differences also help explain the differences between the two groups with respect to family stage — the point in the life cycle of the family. Table 4 shows that half of the open-country families were composed of all adults, and one quarter had a household head of at least 65 years of age. One-third of the rural households had children at the preschool and school levels.

### Education

In view of the predominance of relatively better educated persons employed by the plant, it might be concluded that education is important in the selective process. But plant workers are younger and younger adults usually have more education. Schooling is often a consideration in employing personnel for industry, but usually it is not crucial for less than the most highly skilled jobs. A majority

Table 3.—Martial Status of Plant Workers and Open-Country White Household Heads.

| Martial status | Plant workers | Open-Country White household heads |
|---|---|---|
| | (106) | (224) |
| | Percent | |
| All cases | 100 | 100 |
| Married | 78 | 86 |
| Separated or divorced | 1 | 2 |
| Widowed | 3 | 10 |
| Single | 18 | 2 |

Table 4.—Family Stage of Plant Workers and Open-Country White Families.

| Family stage | Plant Workers | Open-Country White household heads |
|---|---|---|
| | (106) | (224) |
| | Percent | |
| All cases | 100 | 100 |
| All adult family | | |
| Young (head less than 40) | 16 | 5 |
| Middle aged (head 40-64) | 2 | 19 |
| Old (head 65 or over) | — | 25 |
| Preschool family | 28 | 9 |
| School and preschool | 37 | 33 |
| Preschool, school and post-school | 11 | 5 |
| Post-school | 6 | 4 |

of the plant workers had more than eight years of schooling as compared with fewer than half in the open-country group (see Table 5). Nonwhites were in sharp contrast as 35 percent had fewer than five years of schooling and 84 percent fewer than nine years.

**Job Mobility**

Plant workers were the more mobile group, as shown in Table 6. Respondents were asked how many different jobs they had had since 1947, or over a ten-year period. Whereas over half of the open-country resident had not changed jobs, about half of the plant workers had four or more jobs. Only 8 percent of the rural sample had four or more jobs during the decade 1947-1957.

Age is one of the factors, of course, that is related to job mobility. While younger workers have had less time to move from job to job, they generally move about more frequently. Hence, when the open-country residents under 50 years of age—a group that is more nearly comparable to the factory employees—are compared to the plant workers, the mobility pattern is more similar. Even so, the plant workers are still slightly more job-mobile.

Older workers generally show greater employment stability. In Table 7 the age distribution of open-country residents who had not changed jobs is compared with those who had two or more jobs. Since two-thirds of the stable employment group were 55 years of age or older, it is apparant that age is an important factor. Among those who reported multiple jobs there was but slight difference by age.

**Residential Mobility**

Plant workers more often moved from one house to another. Three out of five open-country residents had remained for ten years in the same place of residence as compard with less than one-third of the plant workers. Nearly half the plant workers but less than a quarter of the open-country residents had moved at least three times.

Age needs to be taken into account, since open-country residents over 50

Table 5.—Education of Plant Workers and Open-Country Household Heads, by Color.

| Years of schooling completed | Plant workers | Open-country<br>Total | <br>White open-country | <br>Nonwhite |
|---|---|---|---|---|
| | (106) | (315) | (224) | (91) |
| | | Percent | | |
| All cases | 100 | 100 | 100 | 100 |
| Under 5 | 4 | 16 | 9 | 35 |
| 5-8 | 23 | 49 | 48 | 49 |
| 9-12 | 70 | 32 | 39 | 15 |
| 13 or more | 3 | 3 | 4 | 1 |

Table 6.—Employment Stability of Plant Workers and Open-Country Household Heads.*

| Number of employment changes since 1947 | Plant workers | Open-Country White household heads<br>Total | <br>Those under 50 years of age |
|---|---|---|---|
| | (106) | (220) | (90) |
| | | Percent | |
| All cases | 100 | 100 | 100 |
| One | 16 | 55 | 32 |
| Two | 32 | 23 | 27 |
| Three | 22 | 12 | 23 |
| Four | 15 | 5 | 10 |
| Five or more | 14 | 3 | 7 |
| No answer | 1 | 2 | 1 |

*Difference between plant workers and white open-country group under 50 are not significant at .05 level.

Table 7.—Age distribution of Open-Country White Household Heads by Employment Stability.

| Age | Number of jobs since 1947<br>One or none | <br>Two or more |
|---|---|---|
| | (121) | (94) |
| | Percent | |
| All cases | 100 | 100 |
| Under 25 | 3 | 8 |
| 25-34 | 5 | 24 |
| 35-44 | 10 | 24 |
| 45-54 | 15 | 20 |
| 55-64 | 27 | 11 |
| 65 and over | 40 | 13 |

years of age were less inclined to move than the younger ones. Among plant workers who had not moved for ten years, an intriguing pattern is shown. Half of the "non-mobile" plant workers were under 25 years of age, and an additional 21 percent were between the ages of 25 and 35. Whether the younger plant workers were too young to have made residential moves, whether they were located where they wanted to be, or whether for some reason they were unable to move is a matter of speculation.

In any event it appears that young plant workers did not have to change residence to obtain industrial employment. Open-country residents were about as mobile residentially as plant workers of the same ages (Table 9). And residential mobility decreased with age for the open-country sample, whereas mobility may increase up to age 40 and then decline for the plant workers. Here, as so often throughout this analysis, the small number of cases, especially among plant workers, casts some doubt on patterns observed. Cross-classification resulted in only 10 plant workers between 40 and 49

Table 8.—Residential Stability of Plant Workers and Open-Country White Household Heads.

| Number of residences since 1947 | Plant workers | Open-Country White household heads |
|---|---|---|
| | (106) | (224) |
| | Percent | |
| All cases | 100 | 100 |
| One | 31 | 58 |
| Two | 22 | 20 |
| Three | 19 | 10 |
| Four | 17 | 5 |
| Five | 7 | 4 |
| Six or more | 4 | 3 |

Table 9.—Residential Stability of Plant Workers and Open-Country White Household Heads by Age for Those Under 50 Years of Age*

| Number of residences since 1947 | All cases | Age (in years)<br>Under 30 | <br>30-39 | <br>40-49 |
|---|---|---|---|---|
| Plant workers | (105) | (58) | (37) | (10) |
| | | Percent | | |
| | 100 | 100 | 100 | 100 |
| One | 30 | 32 | 22 | 50 |
| Two or more | 70 | 68 | 78 | 50 |
| Open-country white household heads | (93) | (24) | (35) | (34) |
| | | Percent | | |
| | 100 | 100 | 100 | 100 |
| One | 38 | 25 | 29 | 56 |
| Two or more | 62 | 75 | 71 | 44 |

*Differences between plant workers and open-country not significant at .05 level.

years of age, or too few to be certain about the observations.

In brief, the foregoing evidence generally supports the proposition that workers recruited in rural areas for industial employment are not representative of residents in the area. Workers employed in the furniture factory were selected to varying degrees according to age, race, marital status, family stage, education and employment and residential mobility.

## INCOME AND LEVEL OF LIVING

A second major objective of this study was to assess the influence of industrialization on socio-economic status and levels of living throughout the community. Having already detected certain selective processes operating in the employment of workers in the plant, pursuit of this objective must proceed with utmost caution. In other words, it is possible that differences in socio-economic status, income and levels of living may be due as much to selectivity based on other factors as to any real influence stemming from the fact that the furniture factory was located in the community.

### Income

On the average, heads of households in the rural sample earned less in 1956 than the plant workers.[3] Half of the plant workers earned at least $3,000 from all sources, while only 13 percent of the open-country group received as much.

Ideally perhaps we should take account of all relevant differences between plant workers and rural residents before comparing the two groups to see whether one is better off economically than the other. This was not possible in the present study, although some of the differences between the two were controlled.

As already indicated, nonwhites were eliminated from the rural area sample for most comparisons of plant workers and rural residents. Reducing the group to whites alone has the effect of raising incomes. Table 10 shows that 21 percent of the white open-country heads of households had incomes of $3,000 or more, still far short of the 50 percent of plant workers with incomes this high. Nearly four in ten rural whites, in contrast, with only one in ten plant workers, had incomes of less than $1,000.

The two groups become even more similar by reducing age differences. The difference of 26 years in the average ages of the two groups might well account for some of the income differences. Since all but one of the plant workers were under 50 years of age, comparison of plant workers with open-country whites under 50 years of age provides a still rough but nearly equated pair of groups. As the righthand column in Table 10 shows, with age and color comparable, 35 percent of the open-country group had incomes of $3,000 or more. This is better than the 13 percent for all open-country heads and the 21 percent for whites. Improvement is noted also in lower income brackets, where the proportion with incomes under $1,000 drops from four in ten to two in ten.

Income earned ordinarily is related to age, and it is usually expected that older workers will have higher incomes than the younger ones. However, Table 11 shows the opposite of this. Half of those under 35 years of age reported incomes of $3,000 or more, while only 24 percent in the age group 35 to 49 and 14 percent between 50 and 64 years did as well. Also, about one out of ten in the younger group earned under $1,000, but four out of ten were under this point in the 50 to 64 age group. As expected, those 65 years of age and over averaged the lowest incomes. Most interesting, however, is the

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[3] Maitland and Wilber, op. cit., p. 13.

**Table 10.—Total Family Income of Plant Workers and Open-Country White Household Heads, 1956.**

| Total family income | Plant worker | Open-Country White household heads Total | Open-Country White household heads Uunder 50 years of tge |
|---|---|---|---|
| | (106) | (220) | (91) |
| | | Percent | |
| All cases | 100 | 100 | 100 |
| Less than $500 | 2 | 18 | 13 |
| $500-999 | 8 | 19 | 8 |
| 71,000-1,999 | 15 | 24 | 22 |
| $2,000-2,999 | 25 | 18 | 22 |
| $3,000-3,999 | 18 | 13 | 20 |
| $4,000-4,999 | 19 | 4 | 11 |
| $5,000 and over | 13 | 4 | 4 |

observation that white open-country heads of households under 35 years of age show an income distribution very nearly like that for all plant workers. For both of these groups, about one-tenth reported incomes under $1,000, four-tenths between $1,000 and $2,999, and half $3,000 or over.

Thus by controlling certain differences between plant workers and open-country residents, differences in incomes tend to diminish. Further evidence of this is shown in Table 12, where open-country whites with nonfarm work have incomes more comparable to plant workers than those with farm work. Half of the plant workers and 45 percent of nonfarm workers in the open-country sample had incomes of $3,000 or more.

## Socio-Economic Status

In addition to comparisons by income, the relative well-being of the two groups was measured by a socio-economic status scale.[4] In brief, the Belcher scale used here is constructed by assigning scores to households on the basis of standard items in and about the house, such as type of construction of the house, possession of furniture and appliances, and so on. High scores are treated as high socio-economic status and vice versa.

If factory wage earnings are generally higher than other income opportunities in the area, the new industry should help increase socio-economic status. Plant

**Table 11.—Total Family Income of Open-Country White Households by Age of Head, 1956.**

| Total family income | All households | Age of head Under 35 | 35-49 | 50-64 | 65 & over |
|---|---|---|---|---|---|
| | (220) | (41) | (50) | (66) | (63) |
| | | | Percent | | |
| All cases | 100 | 100 | 100 | 100 | 100 |
| Under $1,000 | 37 | 12 | 28 | 41 | 54 |
| $1,000-$2,999 | 42 | 39 | 48 | 45 | 36 |
| $3,000 & over | 21 | 49 | 24 | 14 | 10 |

**Table 12.—Total Family Income of Open-Country White Household Heads by Farm and Nonfarm Work, 1956.[1]**

| Total family income | All cases | Farm work | Nonfarm work |
|---|---|---|---|
| | (183) | (128) | (59) |
| | | Percent | |
| All cases | 100 | 100 | 100 |
| Less than $1,000 | 32 | 44 | 6 |
| $1,000-2,999 | 45 | 43 | 49 |
| $3,000 and over | 23 | 13 | 45 |

[1] Retired persons and nonfarm business owners not included.

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[4] See W. H .Sewell, "A Short Form of the Family Socio-Economic Status Scale," **Rural Sociology**, VIII (1943), 161-169; and J. C. Belcher, "Evaluation and Restandardization of Sewell's Socio-Economic Scale," **Rural Sociology**, XVI (1951), 246-255.

Table 13 Socio-Economic Status of Plant Workers and Open-Country Household Heads.*

| Socio-economic status score (Belcher) | Plant workers | Open-country household heads | | |
|---|---|---|---|---|
| | | | White | |
| | | total | total | Under 50 years of age |
| | (106) | (317) | (224) | (91) |
| | | | Percent | |
| All cases | 100 | 100 | 100 | 100 |
| Under 25 | 2 | 18 | 3 | 1 |
| 25-34 | 24 | 33 | 30 | 26 |
| 35-44 | 61 | 32 | 43 | 48 |
| 45 and over | 13 | 17 | 24 | 25 |

*Differences between plant workers and white open-country group under 50 years of age not significant at .05 level.

employees did in fact rank higher on the socio-economic scale than the total open-country sample.[5] However, the selective nature of employment in the new industry suggests that age, sex, color and similar differences should be taken into account in making comparisons. When the socio-economic status scores of open-country whites are compared to those of plant workers the differences are much less than when the entire open-country sample is used. Hence, the differences in socio-economic status scores are partly the result of differences related to color.

Differences in socio-economic status scores diminish further with the reduction of age and color contrasts. When the plant workers and open-country whites under 50 years of age are compared, one in four scored under 35 in both groups and three in four 35 or higher. However, nearly twice as many from the younger open-country group scored 45 or higher than did the plant workers.

**Level of Living**

New industry and industrial expansion are expected to elevate levels of living. The Rural Areas Development Program of the United States Department of Agriculture aims at attainment of higher levels of living in rural areas through programs organized and carried out by local communities with Federal assistance. In a previous report on this survey[6] it appeared that plant workers not only had a higher level of living but had moved ahead more rapidly than rural residents. As a measure of level-of-living, evidence was obtained in this study on the number of household items out of a list of eight possessed by the respondents. Items included were electric lights, running water, refrigerator, washing machine, radio, television, telephone and automobile.

Plant workers fared somewhat better than the white open-country residents in improving their level of living, as shown in Table 14. In 1950 about two out of five among both groups had fewer than three items on the list. The average (mean) number of items possessed in 1950 was 3.4 for plant workers and 3.7 for open-country folks. By 1957 all but 10 percent of the plant workers had four items or more while only about three-fourths of the open-country group had as many. The average items possessed increased to 6.4 for the plant workers and to 6.0 for the open-country residents by 1957. Thus, while both groups improved their level-of-living during this period. plant workers advanced at a somewhat faster rate.

## CHANGES AMONG FARMERS

Industrialization in a low income rural area should leave its mark among the farm residents as well as among those who live in town and work in the factory. In an effort to assess this aspect of the changes wrought by industrialization, open country residents engaged in farming and the plant workers who live and

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[5] Maitland and Wilber, **op. cit.**, p. 13.

[6] Ibid. pp 12-13.

**Table 14.—Levels of Living Among Plant Workers and Open-Country White Household Heads, 1950 and 1957.**

| Number of items owned | Plant workers 1950 | Plant workers 1957 | | Open-Country white household heads 1950 | Open-Country white household heads 1957 |
|---|---|---|---|---|---|
| | (106) | | Percent | (224) | |
| All cases | 100 | 100 | | 100 | 100 |
| None | 14 | — | | 10 | 1 |
| One | 16 | — | | 18 | 1 |
| Two | 12 | 1 | | 13 | 3 |
| Three | 15 | 3 | | 12 | 7 |
| Four | 24 | 6 | | 13 | 13 |
| Five | 11 | 27 | | 21 | 20 |
| Six | 5 | 27 | | 9 | 26 |
| Seven | 1 | 21 | | 4 | 16 |
| Eight | 2 | 15 | | — | 13 |
| Mean number of items | 3.4 | 6.4 | | 3.7 | 6.0 |

also work on a farm may be compared with respect to residential and occupational stability, tenure status, level of living, and social participation. As a matter of convenience, we will refer to the plant workers engaged in farming as **part-time farmers** and the open-country residents engaged in farming as **full-time farmers.**

There were 27 plant workers who were part-time farmers and 118 white full-time farmers. Table 15 shows that the part-time farmers were much younger on the average than full-time farmers. Half of the full-time farmers were 55 years of age or over, but none of the part-time farmers were this old. Even the farm residents who had nonfarm employment tended to be older than the part-time (plant worker)-farmers.

Such age differences are reflected in many ways. Nearly half of the full-time farmers, for instance, and only about a fourth of the part-time farmers had no children present in their families. Children of school age were more often present among the part-time farm families.

## Farms and Tenure

Our part-time and full-time farmers differ with respect to type of farm and tenure status, much in the way that might be expected because of the definitions of these two groups. Once again it is important to control for age between the two groups. Thus the 27 part-time farmers, all under 50 years of age, are compared to the 49 full-time farmers. The "part-time" farmers among our plant workers were predominantly owners of part-time

**Table 15.—Age Distribution of Plant Workers and White Household Heads Who Were Farm Residents.***

| Age | Plant workers | Open-country white household heads who were farm residents: Total | Farm employed | Nonfarm employed |
|---|---|---|---|---|
| | (27) | (133) | (118) | (15) |
| | | | Percent | |
| All cases | 100 | 100 | 100 | 100 |
| Under 25 | 34 | 2 | 2 | — |
| 25-34 | 41 | 11 | 9 | 27 |
| 35-44 | 18 | 18 | 14 | 47 |
| 45-54 | 7 | 19 | 19 | 20 |
| 55-64 | — | 25 | 28 | 6 |
| 65 and over | — | 25 | 28 | — |

*Differences between plant workers and farm residents with non-farm employment not significant at .05 level.

Table 16.—Type of Farm and Tenure, by Age for Household Heads Who Were Under 50 Years of Age and Residing on Farms.[1]

| Type of farm and tenure | Plant workers All cases | Plant workers Under 35 | Plant workers 35-49 | Open-country White household heads All cases | Open-country White household heads Under 35 | Open-country White household heads 35-49 |
|---|---|---|---|---|---|---|
| | (27) | (20) | (7)* | (49) | (18) | (31) |
| | | | Percent | | | |
| Type of farm | 100 | 100 | — | 100 | 100 | 100 |
| Commercial | 26 | 25 | — | 59 | 50 | 64 |
| Part-time | 59 | 65 | — | 29 | 39 | 23 |
| Residential | 15 | 10 | — | 12 | 11 | 13 |
| Tenure | 100 | 100 | — | 100 | 100 | 100 |
| Full owner | 78 | 75 | — | 55 | 67 | 48 |
| Part owner | — | — | — | 8 | 11 | 7 |
| Renter | 22 | 25 | — | 37 | 22 | 45 |

[1]Differences between plant workers and open-country by age not significant at .05 level for type of farm and tenure.

*Percentage not shown because of small number of cases.

farms, and the full-time farmers were more typically owners of commercial scale farms. Table 16 shows that six out of ten part-time farmers and three out of ten full-time farmers operated part-time farms. Also, three-fourths of the part-time farmers were classed as full owners as compared with 55 percent of the full-time farmers.

A majority of both the part-time and full-time farmers had operated a farm for at least 10 years. Among the full owners, white full-time farmers more often reflected a long-time stability of farm operation than part-time farmers, as shown in Table 17. Part of the difference between part- and full-time farmers is probably the result of the younger ages and the relative preponderance of part-time farms among plant workers. A majority of renters had operated farms for less than five years.

## Mobility of Farm Residents

Plant workers living on farms were more mobile than open-country farmers, a pattern similar to that of all plant workers and open-country residents. Half of the plant workers and two-thirds of the open-country farmers had lived in the same house during the ten-year period beginning in 1947. While farmers in the rural area sample were stable in both residence and employment, part-time farmers were much more mobile in employment than they were residentially. Table 18 shows that nine out of ten part-time farmers had two or more periods of employment since 1947 in contrast with only one in three among the open-country farmers. Mobility of both kinds is relatively prevalent among renters and stability characterizes owners of commercial type farms.

## Socio-Economic Status and Level of Living

Full-time farmers scored higher on the socio-economic status scale than part-time farmers. None of the plant group scored higher than 44, as shown in Table 19, but one quarter of the open-country

Table 17.—Years of farm operation for farm residents who were full owners.

| Years of farm operation | Plant workers | | Open-Country White household heads |
|---|---|---|---|
| | (20) | | (94) |
| | | Percent | |
| All cases | 100 | | 100 |
| Under 5 | 25 | | 7 |
| 5-9 | 15 | | 9 |
| 10 and over | 60 | | 84 |

Table 18.—Resiential and employment stability of farm residents who have nonfarm jobs.*

| Number of residences and Jobs since 1947 |  | Open-country White household heads |
|---|---|---|
|  | (27) | (130) |
|  | Percent |  |
| Number of residences | 100 | 100 |
| One | 52 | 68 |
| Two or more | 48 | 32 |
| Number of jobs | 100 | 100 |
| One | 11 | 66 |
| Two or more | 89 | 34 |

*Differences by residences not significant at .05 level.

Table 19.—Socio-Economic Status of Plant Workers and White Household Heads Who Were Farm Residents.

|  |  | Farm residents |
|---|---|---|
| Socio-economic status score (Belcher) | Plant workers | Open-Country White household heads |
|  | (27) | (133) |
|  | Percent |  |
| All cases | 100 | 100 |
| Under 25 | 4 | 4 |
| 25-34 | 29 | 25 |
| 35-44 | 67 | 46 |
| 45 and over | — | 25 |

Table 20.—Value of farm products sold by farm residents in 1956.*

| Value of products sold | Plant worker households | Open-country White households |
|---|---|---|
|  | (27) | (129) |
|  | Percent |  |
| All cases | 100 | 100 |
| Under $250 | 15 | 15 |
| $250-1,199 | 48 | 33 |
| $1,200-2,499 | 29 | 37 |
| $2,500 and over | 8 | 14 |

*Differences not significant at .05 level.

group were above this point. Looking back at Table 13, it appears that farmers among plant workers tend to hold down the socio-economic status of plant workers as a whole, while farmers in the open country area score about the same as all open-country residents. Though none of the plant-worker-farmers scored higher than 44, 13 percent of all plant workers scored above this point.

Partial support for socio-economic differences between plant workers and open-country farmers is found in Table 20 which shows the value of farm products sold in 1956 for both groups of farmers. Nearly two-thirds of the part-time farmers sold products valued at less than $1,200. Only half of the open-country farmers had sales of sales of $1,200 or less

The striking advance in level of living on the part of farmers in the plant labor force, from an average of 2.8 in 1950 to 5.7 items owned in 1957, is shown in Table 21. By 1957 all of the plant-worker-farmers had four or more of the items. In 1950 more than half, 56 percent, did not have as many as four of these items.

## SOCIAL PARTICIPATION

A new industrial plant may introduce changes in the social life of plant employees recruited from the nearby rural community just as employment in an industrial plant is expected to increase levels of living and income of workers from low-income rural areas. Respondents were asked about their past and present memberships in organizations such as churches, social clubs, fraternal organizations, school and other groups. These responses provide an indication of participation in formal group activities, although they are inadequate for a thorough examination of social participation. A social participation score was determined by counting the number of organizational memberships for each individual. Table 22 shows the number of memberships held by plant workers and the white open-country residents.

Differences in social participation between plant workers and open country whites were slight, with both plant workers and open-country residents averaging 2.3 memberships. Previously[7] it was pointed out that neither plant workers nor open-country residents increased or decreased their participation in organizations very greatly after the plant was established. About one in five stated they were taking greater part in organizations after the new plant came in.

Despite the absence of great differences in social participation between the two groups, differences in social participation do appear to bear some relation to residence. From Table 23, farm residence is related only slightly to membership in organizations for plant workers and open-country heads. But plant workers belonged to at least two organizations more often than open-country heads, regardless of whether they lived on a farm or not. Furthermore, residence made little difference for organizational membership of plant workers, whereas in the open country sample farm residents were likely

**Table 21.—Change in level of living for plant workers living on farms, 1950 to 1957.**

| Number of items possessed | Plant workers<br>1950 | <br>1957 |
|---|---|---|
| | (27) | (27) |
| | Percent | |
| All cases | 100 | 100 |
| None | 11 | — |
| One | 26 | — |
| Two | 4 | — |
| Three | 15 | — |
| Four | 26 | 11 |
| Five | 11 | 37 |
| Six | 7 | 26 |
| Eight | — | — |
| Seven | — | 26 |
| Mean number of items | 2.8 | 5.7 |

**Table 22.—Number of Organizational Memberships of All Plant Workers and Open-Country White Household Heads and of Those Living on Farms.***

| Number of memberships | Plant workers | Open-Country White | Farm residents<br>Plant workers | <br>Open-Country White |
|---|---|---|---|---|
| | (103) | (214) | (27) | (126) |
| | | Percent | | |
| All cases | 100 | 100 | 100 | 100 |
| None | 21 | 21 | 15 | 17 |
| 1-2 | 20 | 27 | 30 | 22 |
| 3-4 | 51 | 38 | 47 | 42 |
| 5-6 | 8 | 14 | 8 | 19 |
| Mean number | 2.3 | 2.3 | 2.3 | 2.3 |

*Difference not significant at the .05 level.

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[7] Ibid., pp. 14-15.

**Table 23.—Social Participation of Plant Workers and Open-Country White Household Heads by Residences.***

| Number of memberships | Plant workers |  |  | Open-Country White household heads[1] |  |  |
|---|---|---|---|---|---|---|
|  |  | Residence |  |  | Residence |  |
|  | Total | Farm | Nonfarm | Total | Farm | Nonfarm |
|  | (103) | (27) | (76) | (187) | (138) | (49) |
|  | Percent |  |  |  |  |  |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |
| Under 2 | 33 | 30 | 34 | 42 | 38 | 53 |
| 2 or more | 67 | 70 | 66 | 58 | 62 | 47 |

[1] Excludes retired persons.

*Only the differences between the nonfarm groups are significant at the .05 level.

**Table 24.—Social Participation of Plant Workers and Open-Country White Household Heads By Family Stage.***

| Number of memberships | Family Stage |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  | Plant workers |  |  |  | Open-Country White household heads |  |  |  |
|  | All adult |  | Children present |  | All adult |  | Children present |  |
|  | Young | Old | Preschool and school age only | One or more post-school age | Young | Old | Preschool and school age only | One or more post-school age |
|  | (18) | (0) | (68) | (17) | (50) | (53) | (90) | (20) |
|  | Per cent |  |  |  |  |  |  |  |
| Total | 100 | — | 100 | 100 | 100 | 100 | 100 | 100 |
| Under 2 | 22 | — | 35 | 35 | 34 | 49 | 43 | 60 |
| 2 or more | 78 | — | 65 | 65 | 66 | 51 | 57 | 40 |

*Differences not significant at .05 level.

to belong to more groups than nonfarm residents.

The presence or absence of children in the home as well as the ages of parents will influence social participation. The number or organizational membership reported by plant workers and white open-country household heads is shown in relation to family stage in Table 24. About four out of five in both groups reported one or more memberships, and 67 percent of the plant workers but only 58 percent of the open country sample reported two or more memberships. Over half of the plant worker families had preschool children, or both preschool and school children, and among these families a majority reported two or more group memberships. But proportionately fewer of the plant families with young children reported multiple memberships than did those with no children or with children beyond school age.

The extent and character of social participation is known to be influenced by the level of family income. Generally, families with higher incomes belong to more organizations. Table 25 provides evidence of this tendency. Three out of four plant workers with family incomes of $3,000 or more reported two or more organizational memberships. But among open-country residents the income and membership are less clearly related as half of those in the lower income group and about 60 percent in the two higher income groups reported multiple memberships.

Measures of socio-economic status and income often depict the same sort of relationship to other factors. This is essentially the case here, as comparison of Tables 25 and 26 show. The proportion of plant workers with multiple memberships increases with socio-economic status as it did with income. However, for white

**Table 25.—Social Participation of Plant Workers and Open-Country Household Heads by Total Family Income.***

| | Total family income | | | | | |
|---|---|---|---|---|---|---|
| | Plant workers | | | Open-Country White household heads | | |
| Number of memberships | Under $1000 | $1000-2999 | $3000 & over | Under $1000 | $1000-2999 | $3000 & over |
| | (11) | (40) | (52) | (75) | (91) | (44) |
| | Percent | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |
| Under 2 | 54 | 35 | 27 | 49 | 40 | 41 |
| 2 or more | 46 | 65 | 73 | 51 | 60 | 59 |

*Differences not significant at .05 level.

**Table 26.—Social Participation of Plant Workers and Open-Country White Household Heads by Socio-Economic Status.**

| | Socio-economic status Score (Belcher) | | | | | |
|---|---|---|---|---|---|---|
| Number of | Plant workers | | | Open-country white household heads | | |
| Membership | Under 35 | 35-44 | 45 and over | Under 35 | 35-44 | 45 and over |
| | (28) | (61) | (14) | (66) | (96) | (52) |
| | Percent | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |
| Under 2 | 54 | 26 | 21 | 58 | 43 | 29 |
| 2 or more | 46 | 74 | 79 | 42 | 57 | 71 |

open-country household heads the relationship is sharper between multiple membership and the measure of socio-economic status than was true for income.

Farm residents among both plant workers and open-country residents differed but slightly in organizational participation (Table 23). Among plant workers living on farms, 70 percent reported more than one membership as compared with 64 percent of white open-country farm residents. Open-country farm residents, however, averaged slightly more memberships—2.6 as compared with 2.3.

## FEELINGS ABOUT THE COMMUNITY

Changes in the opinions of residents concerning various aspects of community life are among the potential changes following establishment of an industry in a community In this study the question was asked, "Would you say that in the past five years any of the following have changed for the better, the worse or remained about the same in the community?" Respondents then were asked to comment on such things as schools, churches, neighborliness and community pride. A majority of all respondents indicated they felt the factory was good for the community, with plant workers being more optimistic than open-country folks.

Generally there was close agreement among residents on their opinions toward various aspects of the community. People who thought schools were better since the factory went into operation also felt that churches, neighborliness and other aspects of community life were better. Half of the open-country residents and more than half of the plant workers indicated they thought the schools had improved, as shown in Table 27. Also, half of the open-country group felt that there had been little change in the schools while about a third, 35 percent, of the factory workers agreed. Two-thirds of those in both groups who said they thought churches in the community were better also stated that schools were better. However, among the open-country folks nearly three in four, as compared with three in five, of the factory workers felt that little change had taken place with respect to churches also felt that schools were about the same.

Opinions are likely to be related to various traits of the individual expressing them. Opinions about schools, churches and other group activities of the community may be related to a host of characteristics of the individual, such as his age, occupation, family stage, residential mobility, income and extent of his social participation. While the number of combinations of such interrelationships and the smallness of the sample prohibit an exhaustive analysis here, a few illustrations may suggest certain patterns.

In Table 28, opinions of the plant workers and open-country residents toward schools are shown in relation to the age of the respondent. Comparisons between the two groups are confined again to those under 50. Both plant workers and open-country residents aged 35 to 49 years more often indicated a favorable attitude towards the schools than did younger respondents.

Persons who have moved less frequently might be expected to express more favorable opinions about schools or at least to have more information about the local schools on which to base an opinion. Among plant workers, the persons who had only one place of residence over the previous decade were in fact slightly more favorable towards schools than more mobile persons according to Table 29. Open-country residents displayed little differences when divided into movers and non-

**Table 27.—Opinions About Sschools of Plant Workers and Open-Country Household Heads by Opinions about Churches.**

| Opinions about schools | | Opinions about churches | | |
|---|---|---|---|---|
| since factory came | All cases | Better | Same | Worse |
| Plant workers | (98) | (62) | (36) | (0) |
| | | Percent | | |
| | 100 | 100 | 100 | — |
| Better | 57 | 68 | 39 | — |
| Same | 35 | 21 | 58 | — |
| Worse | 8 | 11 | 3 | — |
| Open-country white household heads | (210) | (100) | (97) | (13) |
| | | Percent | | |
| | 100 | 100 | 100 | 100 |
| Better | 49 | 70 | 27 | 54 |
| Same | 49 | 27 | 72 | 33 |
| Worse | 2 | 3 | 1 | 8 |

**Table 28.—Opinions About Schools of Plant Workers and Open-Country White Household Heads by Age.***

| Opinions about schools | | Age | | |
|---|---|---|---|---|
| since factory came | All cases | Under 35 | 35-49 | 50 and over |
| Plant workers | (99) | (77) | (21) | —[1] |
| | | Percent | | |
| | 100 | 100 | 100 | — |
| Better | 58 | 53 | 76 | — |
| Same or worse | 42 | 47 | 24 | — |
| Open-country white household heads | (212) | (40) | (49) | (123) |
| | | Percent | | |
| | 100 | 100 | 100 | 100 |
| Better | 49 | 38 | 59 | 49 |
| Same or worse | 51 | 62 | 41 | 51 |

[1] Only one plant worker was over 50 years of age.

*Differences not significant at .05 level.

movers.

The majority of those with higher incomes expressed the opinion that schools had improved. In Table 30, 60 percent of the factory workers and 54 percent of the non-country residents in the income bracket of $3,000 or more said schools were better.

People who are relatively active and involved in community affairs express their opinions from a background of greater activity and experience in community organizations. Therefore, their reactions to various things that happen in a community have a special interest. Plant workers who belonged to some organization were slightly more inclined to say schools had improved, 59 percent, than non-members, 44 percent, as shown in Table 31. Organizational membership, however, made virtually no difference in the open-country group's opinions about schools. Hence, for whatever reason, organizational membership had relatively little influence on opinions about school improvement among these respondents.

Table 29.—**Opinions About Schools of Plant Workers and Open-Country White Household Heads by Residential Stability.***

| | Number of residences since 1947 | | | |
|---|---|---|---|---|
| | Plant workers | | Open-country white household heads | |
| Opinions about schools since factory came | One | Two or more | One | Two or more |
| | (33) | (66) | (123) | (89) |
| | Percent | | | |
| All cases | 100 | 100 | 100 | 100 |
| Better | 64 | 55 | 48 | 51 |
| Same or worse | 36 | 45 | 52 | 49 |

*Differences not significant at .05 level.

Table 30.—**Opinions About Schools of Plant Workers and Open-Country Household Heads by Total Family Income.***

| | Total family income | | | | | |
|---|---|---|---|---|---|---|
| | Plant workers | | | Open-country white household heads | | |
| Opinions about schools since factory came | Under $1000 | $1000-2999 | $3000 or more | Under $1000 | $1000-2999 | $3000 or more |
| | (10) | (39) | (50) | (72) | (90) | (46) |
| | Percent | | | | | |
| All cases | — | 100 | 100 | 100 | 100 | 100 |
| Better | — | 56 | 60 | 49 | 48 | 54 |
| Same | — | 39 | 30 | 49 | 49 | 46 |
| Worse | — | 5 | 10 | 2 | 3 | — |

*Differences not significant at .05 level.

Table 31.—**Opinions About Schools of Plant Workers and Open-Country White Household Heads by Social Participation.***

| | Social participation | | | |
|---|---|---|---|---|
| | Plant workers | | Open-country white household heads | |
| Opinions about schools since factory came | No membership | One or more memberships | No memberships | One or more memberships |
| | (16) | (80) | (48) | (160) |
| | Percent | | | |
| All cases | 100 | 100 | 100 | 100 |
| Better | 44 | 59 | 46 | 49 |
| Same | 56 | 31 | 54 | 48 |
| Worse | — | 10 | — | 3 |

*Differences not significant at .05 level.

## SOME IMPLICATIONS

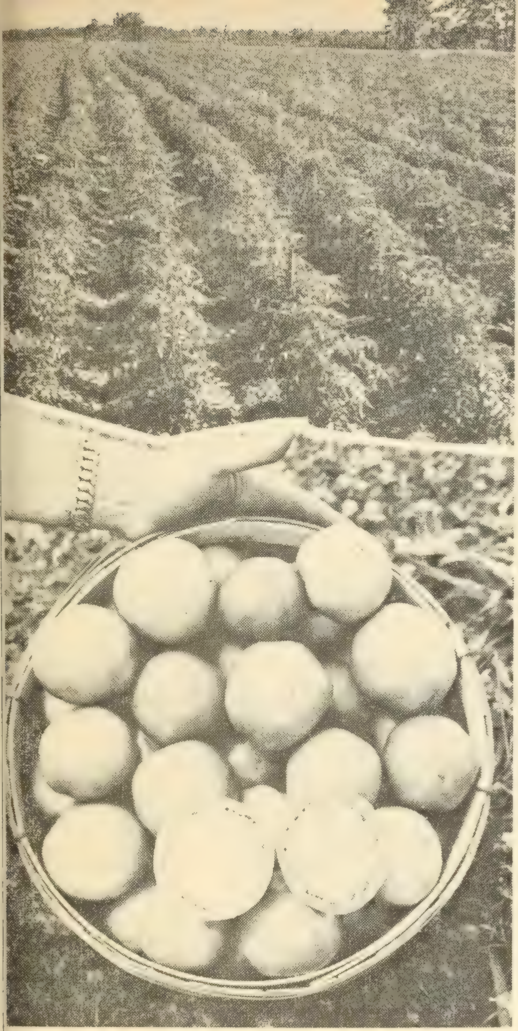
Neither the long-run effects nor all the specific short-run effects of a new factory in a rural community have been examined here. This study has moved in the direction of identifying some of the more immediate consequences of a new factory in the community. Despite such obvious limitations as the small number of interviewees—too few to permit elaborate analysis and detailed cross-classifications —data in this study suggest several important considerations.

There is little question that a new factory in a low-income rural community helps provide jobs and incomes. But the selective nature of living and employment practices combined with migration potential places special importance on the factory jobs provided. Young white males may be deterred from moving away with the coming of the factory. Over the long run, however, keeping these people in the community depends on such things as the steadiness of employment and the opportunities for better earnings. Nation-wide conditions too play an important part, since opportunities elsewhere may become increasingly attractive. Wages in the furniture factory were relatively low by national standards—low enough to prove unattractive to some of the young farmers in the area.

Factory employment in a low-income community may help elevate level of living and social status. There is much evidence that nonfarm workers enjoy far more of the fruits of our mass production system than do farm workers. Jobs provided in the Chickasaw County factory were unskilled and doubtless are what some would consider "dead end." Living levels are still relatively low and not appreciably higher for the factory workers than the farmer. So despite the gains from factory employment, many will regard the opportunities too limitd in comparison with nonfarm opportunities elsewhere.

Opinions expressed about improvements in the community since the coming of the factory were mainly favorable. At the time of the interviews, however. only a short time had elapsed since the factory was established. Consequently the impact of the factory on opinions may not have been realized fully.

Finally, this study offers support for the notion that farm workers who leave agriculture do so gradually. Some of the plant workers were still farming and the extent of their farm work justifies calling them "part-time" farmers. There is also the interesting prospect that workers in this kind of community may find a combination of farming and factory work a solution to many of their problems.



BULLETIN 653 DECEMBER 1962

# Tomato Production For Fresh Market

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# TOMATO PRODUCTION FOR THE FRESH MARKET

By JOHN A CAMPBELL, STEVE L. WINDHAM and W. O. THOMAS[1]

The tomato is a very important crop in Mississippi for fresh market as well as home garden use.

Its universal consumption, nutritional value, and popular use in salads keep this crop in good demand in all sections of the United States.

In recent years the demand for higher quality in tomatoes has increased and to this end research efforts have been concentrated on breeding improved varieties, better cultural and fertilizer practices along with disease and insect control programs. Considerable study has also been given to the effects of handling and storage on the quality of tomatoes offered consumer through the various markets.

Production of high quality tomatoes requires considerable skill in the use of recommended practices. When these practices are properly applied, growing tomatoes for fresh market can be a very profitable enterprise. The per-acre cost of producing tomatoes is higher than most vegetable crops, ranging from $175 to $200 per acre. Therefore, every recommended practice which eliminates guess work and hazards as far as possible must be used.

Because of readily available markets, both local and distant, tomato production is adaptable as a part or full-time, small or large scale, enterprise at most any location within the State. Small plots of one to three acres, where members of a family perform all labor, fit well into a vine ripe market. In such cases the tomatoes are harvested every two days when color is showing on the fruit. Many growers in the Copiah County area have made from $1,000 to $2,000 gross per acre harvesting and selling tomatoes at vine ripe maturity. Larger acreages requiring extra labor may be better adapted to harvesting at the mature-green stage of maturity and marketing on the green-wrap market. In any case a grower should establish his market connections before going into such an enterprise.

Recommendations in this bulletin are based on the results of many years of research in all phases of production at the Truck Crops Branch Experiment Station.

## Varieties

Many new varieties of tomatoes, developed and released in recent years, have improved quality and yielding capacity along with resistance to certain diseases. Some are better adapted to certain areas than others. Therefore, selection of the variety to be grown is an important decision which could mean the difference between success and failure.

The color of the ripe fruit may be important in deciding on a variety. Varieties which develop full red ripe color are most commonly grown and usually are the best yielders according to trials conducted over many years at the Truck Crops Branch Experiment Station. However, the market in certain locations, or certain individuals may prefer the pinkish red ripe fruit color that is characteristic of the Gulf State variety. The following recommendations are given for each type:

**Red varieties:** Marion and Kokomo have been the highest yielding red-fruited varieties in trials at the Truck Crops Branch Experiment Station for many years. These two varieties are widely grown in Mississippi and grower reports substantiate results obtained at the Station. Both are resistant to Fusarium wilt and produce smooth globe shape fruit that are readily accepted on the market or for home use. Marion fruit are larger, with an average U.S. No. 1 weight of .39 pounds when compared to .36 for Kokomo Where larger fruit are preferred, Marion would be better adapted

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[1] Superintendent, horticulturist and associate horticulturist, respectively, at the Truck Crops Branch Experiment Station, Crystal Springs, Mississippi.

**Pink varieties:** The best pink varieties have consistently produced 75 to 100 bushels per acre lower yields than the best red varieties in trials at the Truck Crops Station. When pink varieties are preferred, however, the following varieties are recommended:

Bradley and Pink Shipper both have produced greater yields than Gulf State Market. They are also resistant to Fusarium wilt whereas Gulf State Market is highly succeptible to this disease. The fruit of Bradley are somewhat larger, having an average U.S. No. 1 weight of .39 pounds as compared to .35 for Pink Shipper. Both varieties have an indeterminant type of plant growth and produce globe shaped tomatoes In general, pink tomatoes have a thinner skin than red varieties and tend to crack to a greater extent with fluctuations in moisture and temperature while fruit are maturing.

### Seedbed and Coldframe Treatment

A common practice of many growers producing tomato plants is to rotate the seedbed site each season or move in "new soil" from the woods or fence row. Other than this, few growers make an effort to control soil borne pest in the seedbed. Soil in old hotbeds and coldframes may be used for more than one year if sterilized after each season or after the removal of each crop of plants. Certain practices must be carefully followed for best results. They are as follows:

1. The soil should be finely pulverized and should contain moisture enough for seed germination. All operations for making a plant bed except seeding should be completed before applying the treatment.
2. For even distribution and penetration the seedbed should be thoroughly watered immediately after application of the soil sterilant.
3. Any equipment suitable for drenching may be used, for example, a greenhouse sprinkler can. When applying dust or granular materials these should be evenly distributed over the soil surface and worked into the top 2 inches of soil.
4. After sterilant application and just prior to planting, break crust and plant seed. Cover lightly and water if necessary.

Experiments at this Station indicate that Mylone, Bedrench, or Vapam as shown in Table 1 will reduce harmful soil borne microorganisms in old hotbed soil.

**Table 1.—Results of tomato sseedbed treatment test.**

| Treatments | Mean stand 2 yr. av. | Rate of cemical per 100 sq. ft. |
|---|---|---|
| Check (no sterilant) | 100 | —— |
| Temporary soil sterilants | | |
| Mylone W-50 | 156* | 1.5 lb. |
| Mylone-85 granular | 169* | 1.5. lb. |
| Bedrench | 224* | 1.5 pt. |
| Vapam | 212* | 1.5 pt. |

*Significantly greater than the check at 5% pt.

**Application:** Vapam or Bedrench—apply 1.5 pints of either per 100 square feet of seedbed area. Dilute with enough water (2 to 4 gallons) to evenly cover the soil surface. Thoroughly water the seedbed immediately after application.

Mylone W-50—apply 1.5 pounds per 100 square feet of seedbed area. Mix with enough water (2 to 4 gallons) to evenlv cover the soil surface.

Mylone-85, granular or powder—evenly distribute and work into the top 2 to 4 inches of soil 1.5 pounds per 100 square feet of seedbed area. Thoroughly water the seedbed immediately after application of Mylone.

Wait 15 to 20 days before planting seed when Bedrench, Vapam, or Mylone is used.

Temporary soil fumigants are more volatile in soil temperatures above 50-F. More effective results may be obtained from their use if applied during the fall rather than early winter. Materials such as Dow-Fume and Chloropicrin may be used. Follow directions on the container.

### Plant Production

Good healthy and vigorous plants to set in the field are essential to success. Therefore, careful attention must be given to the planting and growing or securing desirable plants.

Under Mississippi conditions seed must be planted around January 20 to February 1 in hotbed, greenhouse, or heated coldframe in order to have tomatoes ready for market by the first week in June. The recommended method is to plant seed in seed flats and place in hotbed, or plant seed directly to hotbed. The soil should be treated with temporary sterilizing chemicals well ahead of planting (see section on seedbed and coldframe treatment). A good planting soil can be prepared by mixing two parts good loamy field soil with one part sand and one part well rotted chicken litter or barnyard manure.

It is recommended that seed be sown in rows or drills 2½ to 3 inches apart and covered about ¼ inch deep. This will make possible the removal of plants in bunches and reduce the loss of roots when the plants are pulled for transplanting to flats or coldframe (See Figures 1 and 2). One ounce of tomato seed is usually required for the area covered by one hotbad sash 3 feet wide and 6 feet long, or each 18 square feet of bed space. This should produce enough plants for one acre in the field.

For best germination the soil temperature should be 70° to 75° F. This can be easily maintained by use of thermostatically controlled soil heating cable. Other sources of heat can be used but the cable is the most satisfactory. Experiments at this Station have shown that plants started in the hotbed with electric soil heating cable were superior, and required less electricity than plants started in coldframes with soil heating cable or electric light bulbs as a source of heat. This was due primarily to the lower heat. loss in the hotbed compared with the other structures.

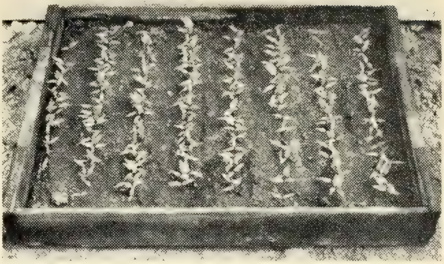

**Figure 1.—Tomato seedlings grown in flat ready for transplanting to other flats or coldframe.**

These studies showed that the consumption of electricity for heating a hotbed 6 feet wide and 36 feet long or 12 sash (Figure 3) was approximately 300 KWH which on the average home load and rate would cost $4.80 for the size hotbed just mentioned, or about 40c per sash covered area. Lead covered cables were used in these studies. Plastic covered cable is now available at lower cost.

When seed germinate and plants emerge care should be taken to ventilate when outside temperature will permit. Sunlight through glass or clear plastic covering generates considerable heat so that the sash should be raised or pushed up and down alternately when outside temperature reaches 45°F. or above with no air movement (See Figure 4). If plants begin growing nitrogen rapidly, the electricity can be cut off when temperature is above freezing, thereby reducing the rate of growth. Add water between the drills as needed to prevent excessive wilting without getting plants wet. This is usually

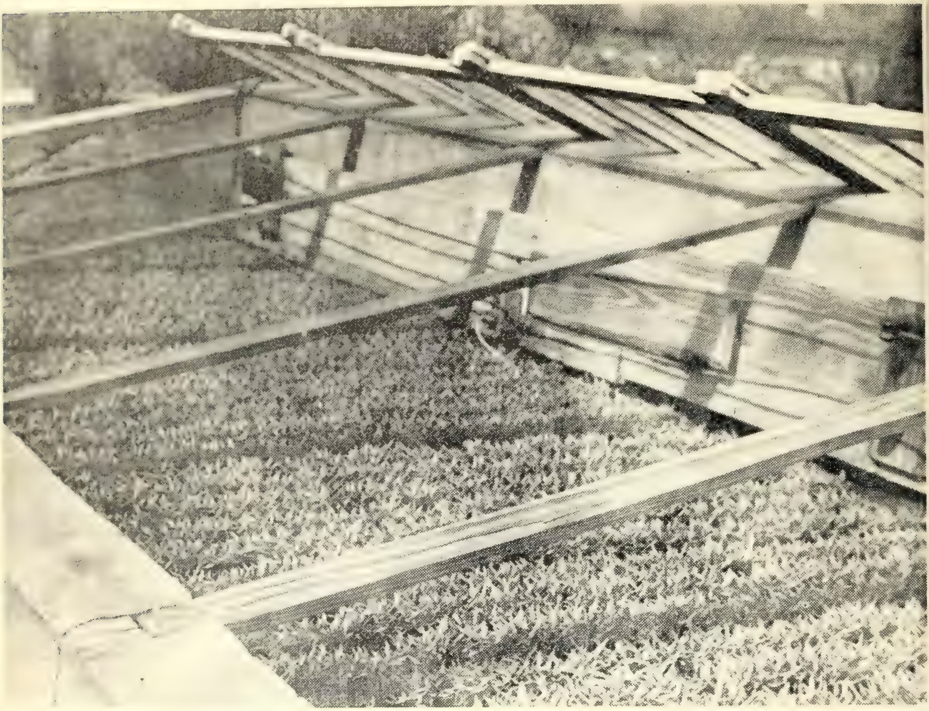

Figure 2.—Tomato plants grown in electrically heated hotbed ready to transplant to flats or coldframe.

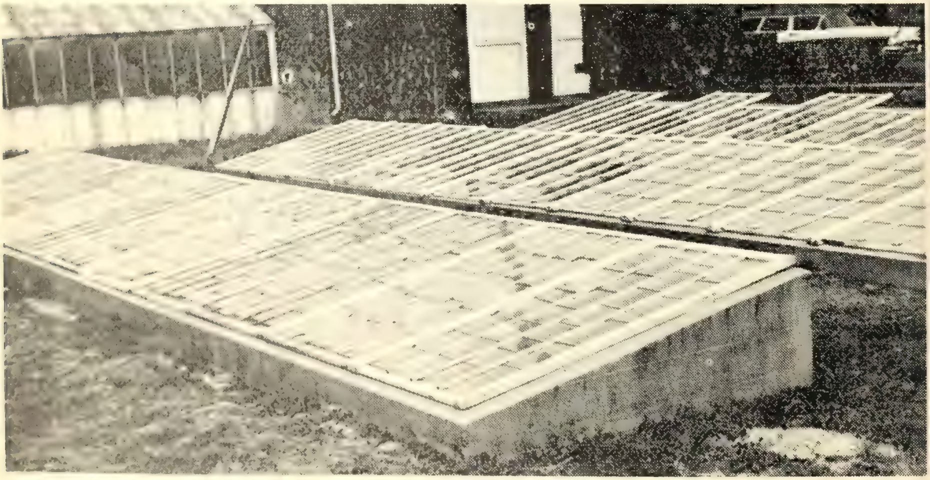

Figure 3.—Hotbeds 36 feet long and 6 feet wide requiring 12 sash. Amounts of electricity used to heat hotbed from time seed were planted until plants were transplanted to coldframe was 300 KWH at a cost of $4.80 or 40 cents per sash.

best done with a water hose at low volume.

When temperatures drop to below 20° F. additional protection may be needed. This can be supplied by covering the hotbed with a coldframe cloth or tarpaulin and banking straw to a depth of 8 to 10 inches over the top and sides of the hotbed. When temperature is above 20°F. the cloth or tarpaulin will be adequate without straw, provided the electric cable or other source of heat is on. The cloth cover should be removed when temperature gets to 30°F. or above in order to provide adequate light to the plants. In order to exercise proper control over the hotbed frequent checks must be made during each day.

**Transplanting to coldframe:** The coldframes should be prepared 2 to 3 weeks before setting. The standard coldframe that will hold enough transplanted plants for one acre is 10½ feet wide and 64 feet long. The general appearance and construction is shown in Figure 5. If plants are to be transplanted directly to the coldframe, each coldframe should be fertilized with a broadcast application of 50 pounds of 5-10-5, or equivalent, worked into the soil. The bed should be worked up well with hoe or potato digger and raked off, removing all trash, grass and clods. The bed should be sloped from center to sides with the center about 2 inches higher than sides.

Plants should be large enough to transplant around February 15 to 20 when first true leaves appear and plants have reached a height of 2½ to 4 inches. Soil should be loosened around the plant drills so that plants can be pulled in bunches. This will reduce loss of roots. Remove plants from hotbed only in quantities that can be set within a reasonable time, before they start wilting. Place plants standing in a shallow pan or container and add one-half inch of water. Do not let foliage get wet and keep in shade protected from wind.

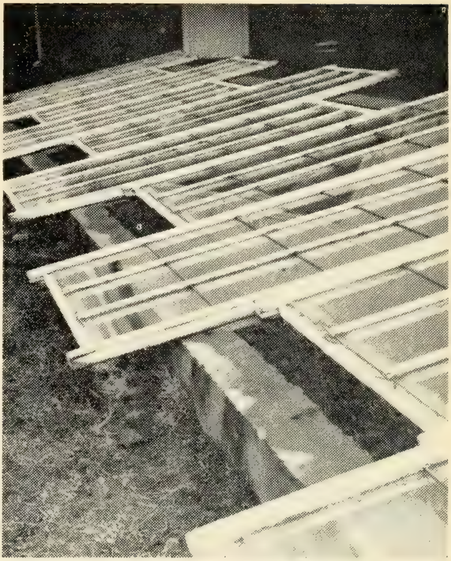

**Figure 4.—Ventilating hotbeds when outside temperature is 45° or higher.**

Holes are made with a multihole puncher, made with pegs 4 inches long spaced 3 inches apart, between 2 pieces dressed lumber 1 in. x 3 in. x 6 ft. (Figure 6). Start making holes at center of bed with rows 3 to 4 inches apart at one end and work toward the other end standing on plank. Holes in the center section are then made and set. Remove plank and make holes and set to complete the full block width of frame. Soil should be packed well around roots.

When one block section is completed cover with one end of coldframe cloth and continue to pull cloth cover up behind setters so that when transplanting is complete the whole frame will be covered and the earlier set plants will have been protected from wilting by wind and sun. Secure the cloth to all sides of frame and add straw to at least two-thirds up each side and across ends. During freezing weather it will be necessary to cover entire frame with straw to a depth of 6 to 8 inches. Either broom sedge straw or pine straw can be used.

After plants have been set for 3 to 5

days, depending on how rapidly they recover from transplanting, remove straw and cloth and spray or dust to control insects. The coldframe should then be covered and ventilated by propping up the cloth at each end. When plants begin to grow and temperature is above 50° to 55°F. remove sheet during warmest part of day. Check the coldframe frequently and if plants begin wilting replace sheet and air the ends of bed.

Use straw cover on sheet only when there is a chance of the temperature going below 30°F. Straw should be removed and bed aired whenever the temperature will permit after each rain. It is well to check weather reports frequently and act accordingly. If there is no chance of frost and plants are making good growth the sheet may be left off at night. This is essential during last week prior to setting in field in order to toughen the plants.

**Use of flats for growing plants:** Transplanting to flats is done much the same way as described for the coldframe. Soil

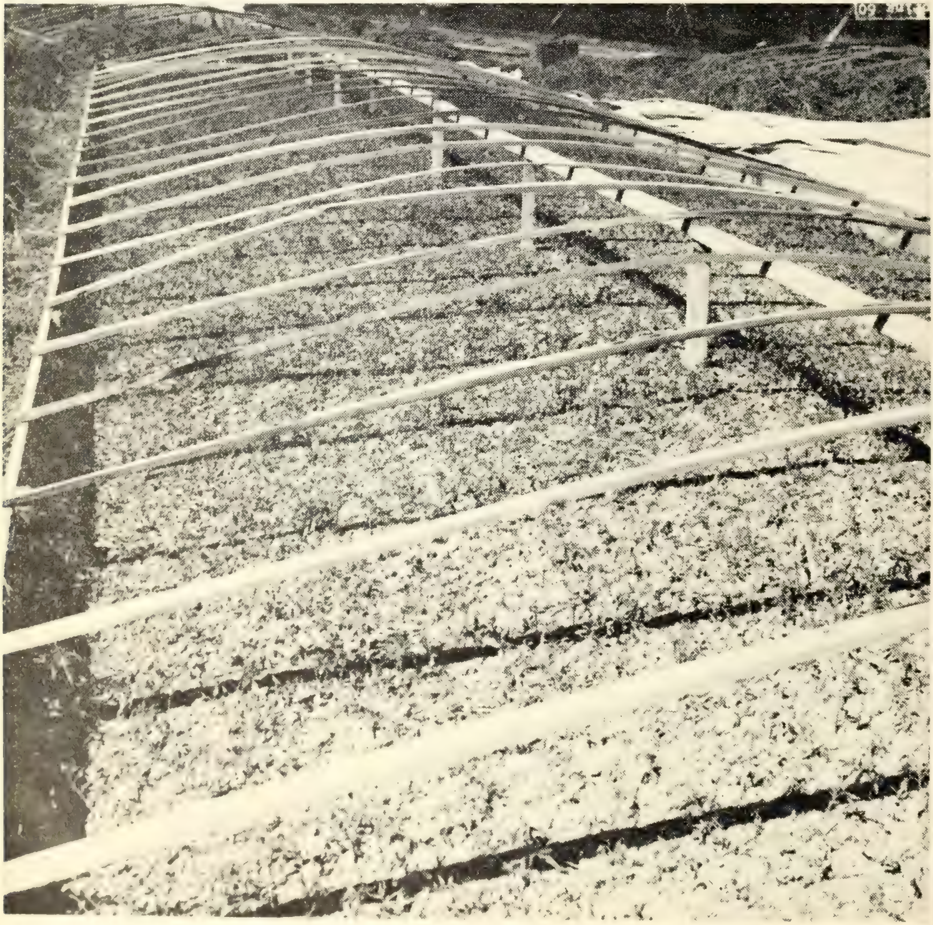

Figure 5.—Typical coldframe construction with seedlings transplanted directly to frame. Plants spaced 3 inches apart in rows spaced 4 inches apart.

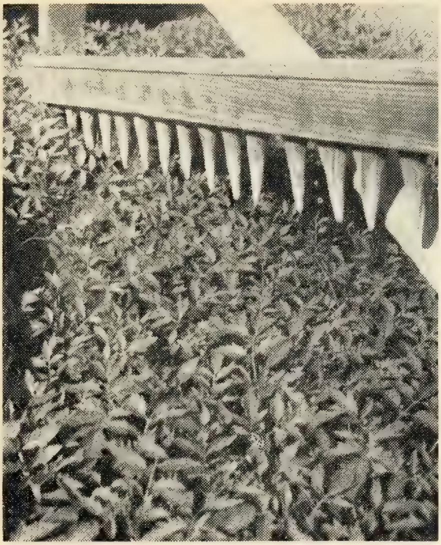

**Figure 6.—A multi-hole puncher used in transplanting plants directly to coldframe.**

in the flats to be transplanted is composed of the same mixture as for planting soil and should be moist. The flats can be stacked under a shed or a barn protected from wind and weather where the transplanting operation can be performed. Flats containing the seedling plants should be well watered and placed near the transplanting operation. Plants should be pulled and transpanted without placing them in a pan of water.

Holes are made with a multipuncher built to fit the flat with pegs spaced 2½ to 3 inches apart as shown in Figure 7. A flat 20 inches long, 15 inches wide and 3 inches deep will hold 40 to 45 plants. Each flat should be well watered immediately after transplanting to prevent wilting. When a sufficient number have been transplanted they can be placed in the coldframe side by side as shown in Figure 8 and covered with the cloth as described above. Operation of the coldframe would be the same as where the plants are set directly in the frame.

No fertilizer is required in the coldframe soil where flats are to be placed. However, the soil should be worked up and raked off so the flats will rest level. The flats should be watered as needed while they remain in the coldframe where they tend to dry out to a greater extent.

Use of flats offers several advantages over transplanting directly to the coldframe. They are as follows:

1. Transplanting can be done with greater ease.
2. Transplanting can be better accomplished under unfavorable weather conditions.
3. The plants can be taken to the field in the flats in better condition for setting to the field.

Flats are usually sold in pre-cut or pre-sawed pieces of heart redwood or cypress lumber to be put together after they are received. They have a useful life of from 10 to 15 years depending on how well they are taken care of. Prices (1962) for the knocked down flats range around 65 cents per flat delivered in quantities of 100.

**Coldframe cloth covers:** A coldframe

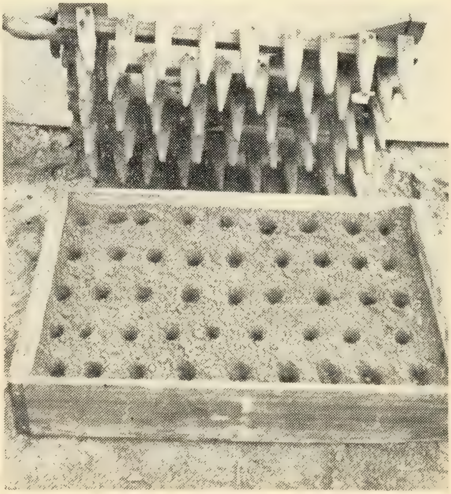

**Figure 7.—Flat prepared for transplanting with multi-hole puncher made to fit. Each flat holds 45 plants spaced 3 in. x 3 in. apart.**

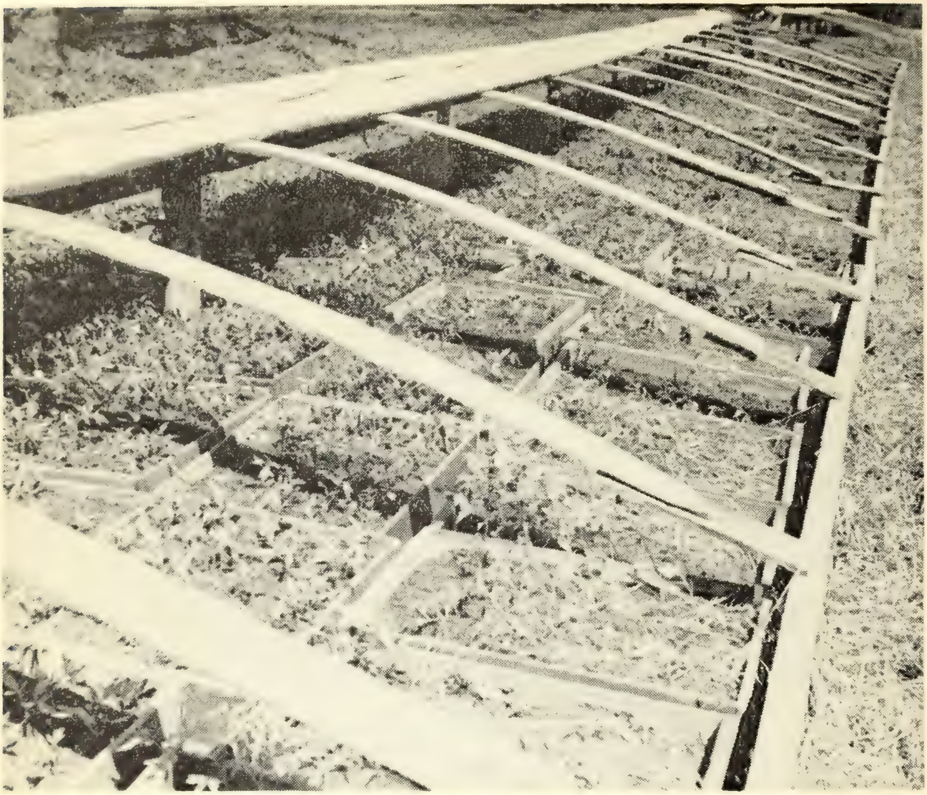

**Figure 8. Coldframe showing transplanted flats set in frame.**

cloth is made by sewing together 4 lengths, each 66 feet long and 36 inches wide of LL grade unbleached domestic cotton sheeting. Roller poles made of 1 in. x 2 in. x 12 ft. are spliced and tacked to the 2 lengthwise edges. This makes it easy to roll the cloth up over the coldframe benders. The cloth is put over the benders so that the loose edges along the seams are up, or exposed to outside, in order to reduce leakage. The price of the 36 in. width cloth should range between 25 to 30 cents per yard in bolt quantities.

### Soil Selection

Soils selected for tomatoes must have good surface and internal drainage, yet retain ample moisture to prevent rapid soil moisture fluctuations. A well-drained silt loam soil with a deep top soil should be used if available. Heavier soils (silt and clay loams) or lighter soils (sandy loams) can be used but require better management practices for maximum yields. Moderate to severely eroded soils and soil types with mottled light yellow and or white subsoils should be avoided. As a precautionary measure soils should not be selected for tomato production on which tomatoes, peppers Irish potatoes, beans, cantaloupes, etc were grown just prior to this crop.

### Soil Preparation

Little can be done to correct poor soil preparation once the plants are established. Prior to transplanting the soil should be broken as deeply as possible with conventional equipment. However, the depth of plowing should be limited to prevent the turning up of raw subsoil. At the time of transplanting the settled seedbed should be approximately 6 inches high after harrowing. The use of a disc harrow or similar equipment may be necessary to obtain a loose, friable bed if seedbeds become compacted between the time of breaking and transplanting.

### Fertilizer Requirement

**a. Pre-transplanting:** Soil samples should be taken and an analyses obtained for soils for which the acidity and fertility levels are unknown. Lime applications should be made on soils with pH levels of 6.0 and below as indicated by soil tests.

Research indicates applying lime on strongly acid soils will increase marketable yields by reducing losses from blossom-end rot and manganese toxicity.

Results of tests over the past 20 years indicate that under most conditions 60 to 80 pounds of N, 120 to 160 pounds of $P_2O_5$, and 60 to 80 pounds of $K_2O$ should be applied as pre-transplanting treatment. In mixed materials, a 1:2:1 ratio should be used. The pre-transplanting fertilizer should be applied at least 2 weeks prior to transplanting. The material is applied in a single band in the center or slightly to one side of the row. The depth should be such that the roots of the plants at transplanting are 1 to 2 inches above the fertilizer band.

**b. Sidedressing:** At the time flowers on the first cluster are in full bloom additional nitrogen and or a complete fertilizer should be added as a sidedressing. This is added 8 to 10 inches to the side on the drill and 2 to 3 inches deep.

Table 2 indicates that larger yields are harvested when a complete, water soluble 1:1:1 ratio fertilizer is used as sidedressing. These data also indicate that sodium nitrate is superior as a source of nitrogen, when nitrogen alone is applied.

### Establishing Plants in Field

The plants should be transplanted to the field between March 20 and April 1. In experiments at this Station, plants grown in flats and transplanted with a block of soil around the roots grew off faster and produced a greater early and total yield of U.S. No. 1 fruit when compared with plants handled by other methods, (Table 3). This method offers a decided advantage over the others. The increased early and total yield during one season would more than pay the cost of the flats which can be used over and over for a period of 10 to 15 years. Cost of 3-inch peat pots (Figure 9) would be

**Table 2.—Influence of sidedressing materials on tomato yields (2 Yr. Av. 1959-1960).**

| Material | Lbs. per acre | Yield (60 lb. Boxes per acre) No. 1 | Total marketable |
|---|---|---|---|
| Ammonium nitrate | 100 | 288 | 323 |
| Sodium nitrate | 200 | 309 | 352 |
| 13-13-13* | 250 | 359 | 395 |

*Water soluble

**Table 3.—Comparison of different methods of production and handling tomato plants as they effect yield of vine ripe tomatoes.**

| Treatment Method of growing and handling plants | Yield — No. 60 lb. Boxes per Acre U. S. No. 1 | U. S No. 2 | Total No. 1 and 2 |
|---|---|---|---|
| Slip rooted plants, roots muddy | 137 | 52 | 189 |
| Coldframe sod plants | 167 | 118 | 285 |
| Flat grown sod plants | 207 | 105 | 312 |
| Transplanted to peat pot plants | 166 | 89 | 255 |
| Seed planted to peat pots same day seeding transplanted in other methods. Thinned to one plant at seedling stage | 167 | 80 | 247 |

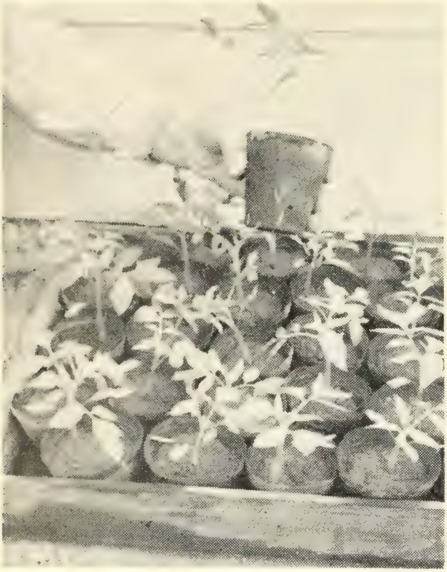

**Figure 9.—Tomato plants grown in 3-inch peat moss pots.**

about equal to that of the flats to produce the same number of plants. The pots would be good for only one season.

Where this method is used, the flats of plants should be well watered before removing to the field. The rows should be harrowed with a section or chain harrow. A small narrow shovel plow run in the center of the top of the row will open a furrow deep enough to receive the plants with a sod of soil around the roots. The setting operation will require teams of two workers, one to carry the flat and the other with a trowel to remove the plants with sod (Figure 10) and set the furrow. Plants should be set to a depth up to the first true leaf. Soil should be packed firmly around each plant.

The second most profitable method is when the plants are grown directly in coldframe and removed with a specially made trowel so that a 3-inch block of soil, intact around roots as shown in Figure 11, can be transferred to the field. Wetting the soil before removing plants will aid in keeping the soil intact. Transfer of plants to the field is made by placing the plants with sod on a slide which has a flat surface. The slide should be narrow enough to be pulled between two rows either by a tractor or mule. The bed preparation and transplanting operation would be the same as described for the use of flat grown plants.

It must be pointed out that where either of the two methods described above are used the soil on which the plants are grown should have a clay or silt content sufficient for the sod to hold its form when removed.

The two methods described above are well adapted to the grower who plants a small acreage. Neither system is adapted to the conventional mechanical transplanter.

For the grower who is mechanized for large acreage production, the slip rooted plants as shown in Figure 12 may prove more economical. With this method the soil in the coldframe is loosened with a fork and the plants pulled bare rooted. The roots are muddied in a mud slurry and transplanted either by hand or mechanical transplanter.

### Spacing

Spacing depends primarily on the

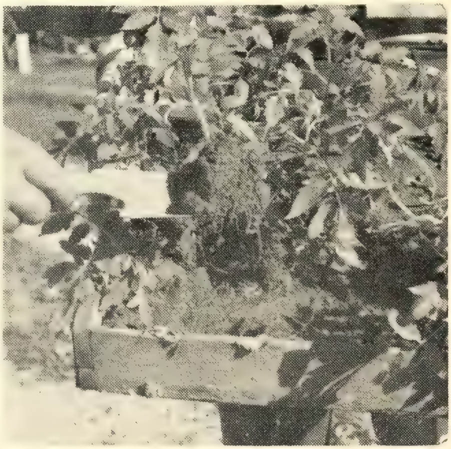

**Figure 10.—Tomato plants grown in flat being removed with sod for transplanting.**

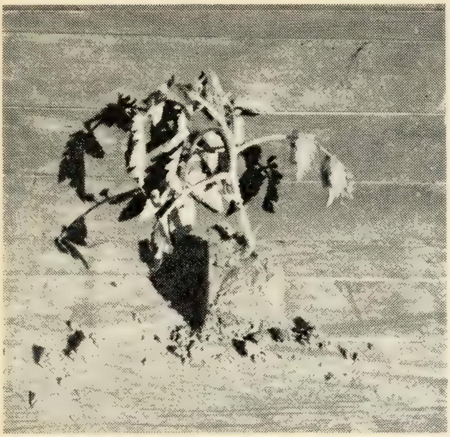

**Figure 11.—Plant grown directly in cold-frame soil removed with sod for transplanting.**

method of training. When tomatoes are pruned, staked and tied, and trained to a double stem, plants should be spaced 2 feet apart on rows 4 feet apart. For untrained plants the plants are spaced 18 inches on rows spaced 7 feet apart. If soil suitable for tomato production is not a limiting factor, distance between rows may be increased for trained plants to facilitate late cultivation and spraying.

Table 4 shows that a larger number of U.S. No. 1 and total marketable fruit can be produced per acre when plants are staked and tied. This is due in part to less area (2 ft. x 4 ft.) required for trained plants as compared to untrained plants (spaced 1.5 ft. x 7 ft.) On the untrained plants a larger number of fruit are lost due to soil rot and discoloration, and more mature fruit are missed during harvesting of untrained plants. The time required to harvest fruit from untrained plants is greater. These factors are more important when fruit are being harvested in the vine ripe stage than for fruit harvested in the mature green stage.

### Training

Plants are normally pruned and tied 3 times, approximately one week apart. The first pruning should take place when the flowers begin to open on the first cluster. All side shoots, sometimes called suckers, are removed below the first two clusters, except the one occurring in the leaf axis immediately below the first cluster as shown in Figure 13. This side shoot is left for the second stem. After the third pruning all additional growth is left. The plants should not be topped.

Stakes may be of wood or metal. They should be approximately ½ to 1 inch in diameter and 40 inches in length. The string used must have a soft finish such as jute twine. Small diameter, hard finish material is not satisfactory as it will girdle the stems of plants. Care must be taken in both staking and tying to prevent fruit from resting against the stake, which will cause scarring of the fruit. The stake originally should be placed on the opposite side of the first cluster. When plants are tied, the plant should be turned to place each subsequent cluster away from the stake.

**Table 4.—Influence of staking and tying on marketable yields of tomatoes (2-Yr. Av. 1959-60).**

| | Yield (60 lb. Boxes per Acre) | |
|---|---|---|
| | No. 1 | Total Marketable |
| Untrained | 172 | 192 |
| Trained | 326 | 368 |

### Cultivation

Cultivate only to control grass and weeds, and to aid in the uptake of water by the soil. The first cultivation is made after plants have recovered from transplanting and are showing signs of growth. This is done with side harrow or a group of small shovel plows. The cultivation should be very shallow close to the plants pushing soil toward the plants and somewhat deeper further away from the plants so as to leave the shoulders and middles of the rows in a uniform pulverized condition. This type of cultivation may be repeated as needed after a rain or as grass and weeds begin to re-appear. Cultivation at this stage can be done

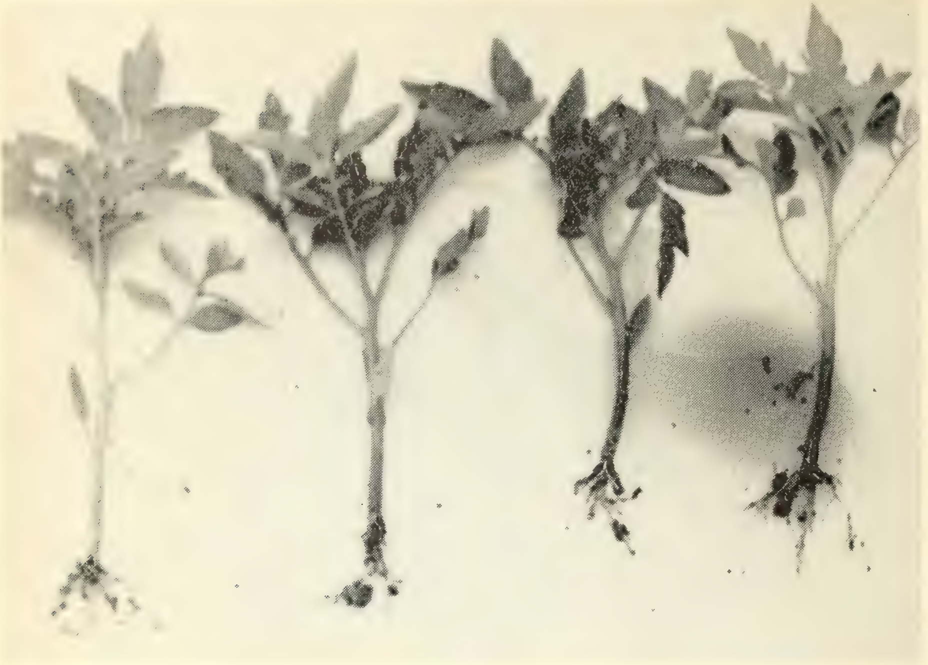

Figure 12.—Good stocky slip root plants 8 inches tall.

either by a mule or tractor.

Just before the plants are to be staked and when the first cluster flowers are in full bloom the plants can be cultivated and given the first sidedressing in the same operation as shown in Figure 14. After the plants have been staked cultivation must be done with mule drawn plows or especially built high clearance tractor. Shovels and sweeps or combination of the two at shallow depths are used after the plants have been staked.

Some hoeing may be required to eliminate grass and weeds in the drill or center of row around and between plants.

### Irrigation

A uniform soil moisture supply is required for maximum yields of marketable grades of tomatoes. The natural rainfall must be supplemented almost every year at one time or another by irrigation in order to meet this requirement. During the month of April and the early part of May the plants should receive 1½ to 2 inches of rainfall or the equivalent in irrigation every 10 days to 2 weeks depending on temperature and amount of sunshine. During the remainder of the growing season the plants should receive this amount of water every 5 to 7 days.

If a drought or a water deficiency is allowed to occur during fruit development a physiological disease known as "blossom-end rot" will occur causing a loss in marketable fruit. The critical period when plants are most susceptible to damage from drought is during the time that tomato fruits are growing and developing. Experiments conducted at the Truck Crops Branch Experiment Station have shown that during the fruit growing period one irrigation of 1½ inches of water during a 2 weeks period without rain, increased the yield of marketable tomatoes by 55 boxes (60 pounds each) per

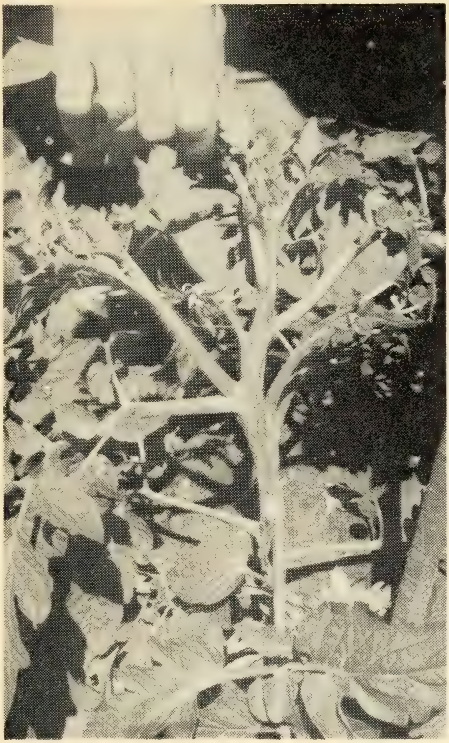

**Figure 13.—The second stem is initiated in the leaf axis just below first cluster.**

acre.

Either sprinkler or furrow flood irrigation may be used.

### Harvesting and Handling

The type market for which the tomatoes are being grown will determine the maturity and how often the fruit are to be picked. There are two types of markets; "vine ripe" and "green-wrap."

**Harvesting for the vine ripe market:** High quality in tomatoes, as measured by soluble solids content and other factors which contribute to flavor and taste, etc., is associated with vine ripe maturity. By the term "vine ripe" we mean that a tomato is left on the vine until color characteristics of a ripening fruit is visible. Tomatoes harvested and sold at this stage of maturity usually bring a premium price. This is due in part to the fact that grocery shoppers recognize visible characteristics of vine ripe tomatoes and discriminate in their favor.

When harvested at this stage, it is necessary to pick the fruit as color is turning or when 10 to 25 percent of the fruit surface is showing color. At this stage of maturity the fruit are firmer and will withstand handling better than when the fruit are ripened to a greater degree. In order to "catch" the bulk of the fruit at this stage it is necessary to pick every second day.

Cloth or metal buckets of 3 to 5 gallon capacity should be used in the harvest. Each fruit should be carefully placed in the container as picked. Tomato fruits are easily bruised and should be handled

**Figure 14.—Cultivating and sidedressing tomatoes just before staking.**

as though they were eggs because within a few hours each bruised area will show up as a dark blotch on the fruit. Growers should not harvest in hampers or other container with rough surfaces, wire or nail ends protruding or any sharp rough edges that will damage the tomatoes.

After harvest the tomatoes should be carefully graded according to United States standards for grades, and packed. The most popular containers for vine ripe tomatoes is the one-half bushel basket lined with paper and the 20-pound wood lug or 20-pound fiber board carton. The fruit should be packed so as to give a neat appearance, usually with the stem end facing downward and to give the net weight indicated on the container. The buyer or shipper will in most instances specify the container to be used.

**Harvesting for the green-wrap market:** Tomatoes for this market are harvested at the "mature-green" stage. The term "mature-green" means that the tomato fruit is matured to the extent that the seed are fully developed and a jelly like substance has developed in the seed cavity. The fruit at this stage will show a brown ring at the stem scar and the light green color at the blossom end will take on a yellow-green cast. At this point the fruit are fully grown and are just before showing a pink or red tinge of color characteristic of a ripening fruit. Usually the position of the fruit on the plant will help determine maturity as the first fruits set on the plant should reach maturity ahead of those set later. A good way to test these indicators and develop experience is to slice thru the fruit with a sharp knife. If the seed and jelly-like substance is fully developed no seed will be cut as they will slip or slide around the knife cutting edge at the mature-green stage. When seed are cut by this slicing, it indicates that the seed and jelly-like substance is not fully developed and that the fruit is not mature enough for this type harvest and market.

Tomatoes for the green-wrap market at the mature-green stage are harvested 3 to 4 days apart using the same care and picking containers as for vine-ripe fruit. In most instances tomatoes are emptied from picking containers into field boxes or paper lined bushel baskets in which they are transported to the market or packing shed where they are to be sold. At the packing shed the tomatoes are graded according to United States standards for grades, and sorted as to size usually by machine. The fruit are then packed in 40 to 60 pound wire-bound crates or fiber board boxes of the same capacity. Green-wrap tomatoes packed in this manner are normally sold to re-pack firms where they are placed in ripening rooms and re-packed in various types of containers for the retail trade.

### Disease and Insect Control for Tomatoes

Tomatoes are plagued by blights, rots and insect damage. For the past ten years most of the growers in Mississippi have produced their own plants. As late blight does not over-winter in this area, this practice is an effective way to prevent this disease. At present the State Plant Board prohibits the shipment of tomato plants out of areas where this disease over-winters.

The primary disease in Mississippi is early blight. Under conditions of severe infection this foliage and fruit disease may drastically reduce the yield. Buckeye and soil rots occur occasionally under extreme weather conditions but are usually of minor importance on staked and pruned tomatoes.

Many of these troubles may be controlled by using recommended fungicides and insecticides. Timely applications of fungicides and insecticides are important practices in tomato producton. The disease and insect control program should be applied as a preventive measure rather than a "cure-all", and control efforts should begin before trouble develops. The insect control measures are given in Table 6.

### Steps in Disease Control

Diseases can be controlled and yields increased by using recommended fungicides. Spray is more effective than dust in controlling leaf, stem, and fruit diseases. Table 5 presents a 3-year average yield of tomatoes produced under the recommended spray schedule. Dyrene and Dithane M-22 treatments produced the highest yield of marketable tomatoes for a 3-year average.

The following steps in a tomato disease control program are essential:

1. If home grown plants are used, apply first spray application in the coldframe about two weeks before transplanting.

2. Begin field spray program about 2

**Table 5.—Effects of fungicides on yield of marketable tomatoes.**

| Spray Treatment | Pounds fungicide in 100 gals. of water | 3-Year Av. Yield. no. 60 lb. boxes per acre | Early blight[1] disease on foliage Mean |
|---|---|---|---|
| Check | -- | 229 | 4.0 |
| Tribasic Copper Sulphate | 4 | 259 | 2.0 |
| Dithane Z-78 or Parzate | 2 | 249 | 2.0 |
| Dithane M-22 or Manzate | 2 | 292 | 1.5 |
| Dyree | 2 | 329 | 1.0 |

[1] 1—very slight, 2—moderate, 3—severe, 4—very severe.

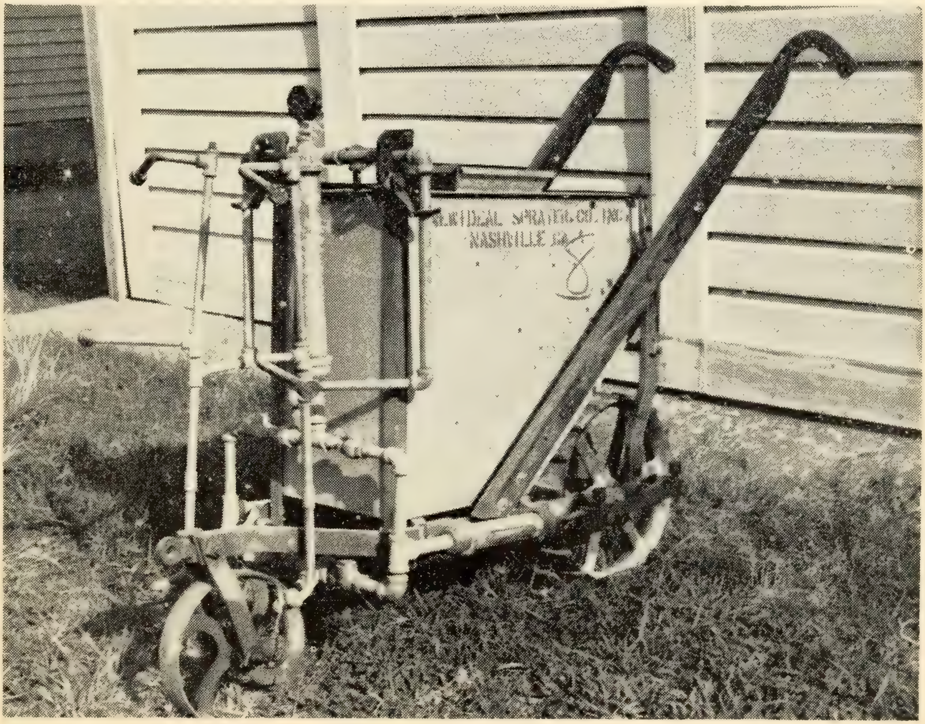

**Figure 15.—A mule drawn sprayer. Pressure provided by pumps operated by rear wheels. This sprayer does an adequate job of applying fungicidal and insecticidal sprays.**

Table 6.—Schedule for Tomato Insect Control.

|  |  | Dust | Spray |  |
|---|---|---|---|---|
|  |  |  | Rates below are per acre. |  |
| Insects | Schedule | Apply approximately 15 to 20 lbs. per acre for good coverage | In large plants use approximately 100 gals. water per acre | Comments |
| Cutworms — in coldframe or field | Treat soil surface in coldframe and tops of rows in field just prior to transplanting. | Toxaphene, Endrin, or Dieldrin | Toxaphene, Endrin or Dieldrin, for small amounts one teaspoon per gallon. | Follow rates and directions on container for soil application. |
| Grass worm in coldframe | First application about three days after transplanting. Treat as needed. | 4% or 5% Malathion<br>10% Sevin | Malathion or Sevin, for small amounts one teaspoon per gallon. | Do not dust or spray excessively. Too much will burn young plants. Use only enough for uniform coverage. |
| Aphids (plant lice) in coldframe or field | Begin control when aphids appear and continue until plants are clean. | 4% or 5% Malathion | 1 to 1½ lbs. Malathion | Watch for infestation. Repeat application as necessary. |
| Fruit insects: pin worm, tomato fruit worm, horn worm | Begin treatment at first fruit set. Add insecticide to each fungicide application. |  | 1 lb. Methoxochlor or 1 lb. DDD, or 2½ lbs. Sevin | Repeat application at 5 to 7 day intervals, follow restrictions on label. |
| Green stink bug | This insect may begin feeding during early season and continue damaging fruits until harvest. | 10% Sevin,<br>20% Sabadilla | 2½ lbs. Sevin | Damage may be noted by small sunken or freckle like spots on green fruit. On mature fruit the area just under the skin is gray and corky in appearance. |
| Colorado potato beetle | Apply insecticide at first sign of damage or insect. Usually two applications will give control. | Endrin,<br>10% Sevin | ¼ to ½ lb. Endrin or Dieldrin | Do not apply after fruit begins to set. |

CAUTION: Read and follow directions and restrictions given on label. Handle concentrates with great care.

weeks after plants have been transplanted in the field.

3. Apply treatments every 7 to 10 days until harvest begins.

4. For good coverage use power equipment.

5. If rain occurs repeat application as soon as possible. Use any of the following materials:

a. Tribasic copper sulphate; 4 lbs. to 100 gal. water.

b. Dithane M-22 or Manzate; 2 lbs. to 100 gal. water Use a sticker spreader.

c. Dyrene; 2 lbs. to 100 gal. water.

For good coverage when using wettable powders in spray, a wetting agent of some type should be used Several commercial preparations are on the market. All are sold as "sticker spreaders". Directions on the container should be followed for each one.

Mix recommended fungicide and insecticide together and apply in one application.

The one-row mule drawn sprayer in Figure 15 is very economical and efficient in operation. This equipment can be adjusted to spray staked tomatoes and other vegetable crops. Pressure is created by rear wheel traction which operates 2 pistons connected to the spray line. Most of the sprayer parts are plumbing accessories and can be obtained or replaced at most hardware stores.

BULLETIN 654 JANUARY 1963

# Retention Of Vitamin C In Turnip Greens

## Cooked by Three Different Methods

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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# RETENTION OF VITAMIN C IN TURNIP GREENS COOKED BY THREE DIFFERENT METHODS

By ANN R. STASCH and LOIS KILGORE, Home Economics
and B. F. BARRENTINE and J. D. CAIN, Chemistry

Turnip greens can provide a good dietary source of vitamin C for the people of Mississippi. Two or three generous servings of turnip greens per day can supply the entire recommended dietary allowance of vitamin C. The actual amount of vitamin C provided by one serving of turnip greens is, of course, variable. Part of this variation is due to difference in the amount of vitamin C contained in the turnip greens when they are harvested. The consumer has very little control over this, particularly if greens are purchased. Other variation results from the method used for cooking the greens. The person preparing the greens does have some control over this variable. The extent to which she exerts this control depends on her knowledge of its importance. This bulletin presents data on the vitamin C content of turnip greens before and after cooking by three methods in common household use. Recommendations are made as to the best method of preparation.

## Review of the Literature

An extensive literature exists concerning the change in vitamin C content of various vegetables after they are cooked. Although most of this literature deals with vegetables other than turnip greens, certain general principles are applicable to all green vegetables.

When green vegetables are boiled the actual destruction of vitamin C is quite small. However, some of the vitamin C originally present in the vegetables is lost by extraction into the cooking water. When "pot liquor" is used for other purposes in food preparation, rather than thrown away, this loss becomes negligible. Variation in cooking method may also increase or decrease this loss. For example, slow simmering of vegetables, compared with cooking at the normal rate of boiling, increases the amount of vitamin C extracted into the cooking water (3). Long periods of time used for cooking turnip greens also result in a greater loss of vitamin C (6).

Although greater destruction of vitamin C by oxidation occurs during steaming of vegetables, less extraction into the cooking water takes place. Therefore, a greater retention of vitamin C occurs in steamed than in boiled vegetables. The greater destruction of vitamin C which occurs during steaming has been reported to be due to the fact that steam diffuses through the packed leaves more slowly than hot water penetrates. The air trapped between the leaves of turnips or other plants contains oxygen which reacts with vitamin C to oxidize and destroy it. If this air is removed rapidly, such as occurs when the leaves are plunged into hot water, very little time is available for oxidative destruction of vitamin C. This explanation forms the basis for the recommendation that green vegetables be placed in water which is already boiling, rather than in cold water (5).

Recommendations for cooking turnip greens usually include all of the abovementioned points.

Acknowledgement is made to Mrs. Sue Woody, Technical Assistant in the Home Economics Department, and to Mrs. Gladys F. Boyette, Extension Specialist in foods and Nutrition, for their suggestions and criticism during the preparation of the manuscript.

### Objectives

The amount of vitamin C retained in cooked turnip greens, and therefore, the nutritive value of the greens, depends upon the method of cooking. Three methods in common household use are pressure cooking, short time boiling in minimum amounts of water and long time boiling in large amounts of water. Turnip greens, specially grown to contain variable amounts of vitamin C, were cooked by each of three methods and analyzed to determine the change in vitamin C content during cooking. From this data recommendations can be made as to preferred method of cooking for maximum vitamin C retention.

### Experimental Procedure

Shogoin and Purple Top White Glove turnips were grown on three experimental plots. Plot 1 received 2000 pounds per acre 8-8-8 fertilizer. Plots 2 and 3 received 3800 pounds per acre of 8-8-8 fertilizer and 900 pounds per acre of sodium nitrate. Excessive amounts of nitrate fertilizer have been shown to decrease the vitamin C content of turnip greens (7). Plots 1 and 2 were grown without artificial shading. Plot 3 was artificially shaded with plastic screening material, which decreased the light intensity 45 per cent. Turnip greens grown in shade are known to contain less ascorbic acid than those grown in direct sunlight. (1)

Turnip greens were harvested from each plot at weekly intervals. The same day each week was used for each plot and the turnip greens were harvested at the same time each day. The greens were washed thoroughly three times. Individual leaves were then cut in half down the mid-rib and blotted dry. Sufficient half leaves to make a weight of 300 grams were used for each cooking method. The other halves of the same leaves were analyzed as a raw sample in each case. This procedure helped to eliminate variability among the leaves.

The three cooking methods used were as follows:

1. Seven minutes at 15 pounds pressure with 2/3 cup (159 ml.) water;
2. Twenty minutes in a covered pan with 2 cups (474 ml.) water; and
3. Two hours in a covered pan with 8 cups (1896 ml.) water

One-half teaspoonful of salt was added to the water for each cooking method. The turnip greens were added when the water was already boiling. After cooking, the greens were drained for two minutes to separate the liquid. Both raw and cooked samples were blended to make a homogeneous mixture. Aliquots of each mixture were analyzed for total vitamin C (8). All weights were reported and all calculations were made on the basis of wet weight of turnip greens.

### Results and Discussion

The average amounts of total vitamin C found, in milligrams per 100 grams of raw turnip greens, were as follows: Plot 1- 1993. 1; Plot 2 - 1748.8; and Plot 3 - 1518.2. The variable amounts of vitamin C initially present in the turnip greens enabled us to show whether loss of vitamin C was related to amount present.

**Change in weight during cooking.**

The weights of raw and cooked turnip greens were obtained for each method of cooking and compared to determine loss or gain in weight during cooking. The percent change in weight for the greens from each plot is given in Table 1.

The pressure cooked turnip greens lost an average of 8.0% of their original weight during cooking. The 20-minute boiled turnip greens gained an average of 5.0%, and the 2-hour boiled turnip greens an average of 1.8% of their original weights during cooking. Therefore, the yield of cooked turnip greens was highest for the pressure cooked greens, and intermediate for the 2-hour boiled greens. The lesser weight gain noted in turnip greens boiled in 8 cups of water than in 2 cups is presumed to be due to a

**Table 1.—Change in weight[1] of turnip greens during cooking.**

| Cooking method | Plot 1 |  | Plot 2 |  | Plot 3 |  |
|---|---|---|---|---|---|---|
|  | Cooked wt. | Change | Cooked wt. | Change | Cooked wt. | Change |
|  | gm | % | gm | % | gm | % |
| Pressure cooked | 278.0 | —7.3[2] | 271.4 | —9.5 | 270.8 | —9.7 |
| Boiled 20 minutes | 319.5 | +6.5[3] | 323.0 | +7.7 | 302.6 | +0.9 |
| Boiled 2 hours | 322.4 | +7.5 | 302.6 | +0.8 | 291.2 | —2.9 |

[1] Raw weight was 300 gm in each case.

[2] Minus sign indicates loss in weight.

[3] Plus sign indicates gain in weight.

greater extraction of water soluble material from the turnip greens into the cooking water in the former case.

**Retention of vitamin C in cooked turnip greens.**

The amount of total vitamin C actually destroyed during cooking averaged 51.2% during pressure cooking, 25.3% during 20 minute boiling and 21.4% during 2 hour boiling. Even though less vitamin C is destroyed in the boiled greens, it must be remembered that some of that remaining is dissolved in the cooking liquor. If this liquor is used in other food preparations, the vitamin C in it is utilized by the consumer. More often, however, the cooking liquor, or a large part of it, is discarded, thereby causing the vitamin C dissolved in it to be lost to the consumer.

Since further use of the liquor remaining from the cooking of turnip greens is optional with the individual user, the amount of total vitamin C actually retained in the turnip greens is considered to be of greater nutritional significance. The amounts of vitamin C retained by the turnip greens after cooking are given in Table 2.

From the data in Table 2 it can be seen that maximum retention of total vitamin C occurs in the pressure cooked turnip greens. Minimum retention of vitamin C is found in the 2-hour boiled greens. The initial amount of vitamin C present does not have any effect on the amount retained by the cooked greens. However, since the percentage of the original amount retained is approximately the same in each case, more vitamin C is found in the cooked greens which had the largest amount to begin with.

**Table 2.—Retention of Vitamin C in turnip greens cooked by three methods.**

| Cooking method | Total vitamin C |  |  |
|---|---|---|---|
|  | Raw | Cooked | Retention |
|  | mg/100 gm | mg/100 gm | % |
|  |  | Plot 1 |  |
| Pressure cooked | 133.7 | 59.6 | 44.6 |
| Boiled 20 minutes | 128.9 | 55.2 | 42.8 |
| Boiled 2 hours | 142.7 | 47.1 | 33.0 |
|  |  | Plot 2 |  |
| Pressure cooked | 107.8 | 48.0 | 44.5 |
| Boiled 20 minutes | 115.9 | 48.2 | 41.6 |
| Boiled 2 hours | 113.1 | 34.9 | 30.9 |
|  |  | Plot 3 |  |
| Pressure cooked | 83.9 | 41.8 | 49.8 |
| Boiled 20 minutes | 79.8 | 42.6 | 53.4 |
| Boiled 2 hours | 86.2 | 20.4 | 23.7 |

In order to compare the actual nutritive values of the drained turnip greens cooked by each of the three methods, the data is reported in Table 3 in the form of percentage of the recommended daily dietary allowance supplied by one average serving (2).

The data in Table 3 show that pressure cooked turnip greens provide a larger proportion of the daily requirement of vitamin C in one serving than do the greens cooked by either of the boiling methods. This difference is especially notable in the case of the turnip greens from Plot 3, which contained the lowest amount of vitamin C at harvest.

**Table 3.—Percentage of recommended daily dietary allowance (RDA) of vitamin C found in one serving (72.5 grams, wet weight) of turnip greens cooked by three methods.**

| Method of cooking | Plot 1 | Plot 2 | Plot 3 |
|---|---|---|---|
| | % RDA | % RDA | % RDA |
| Pressure cooked | 58.2 | 44.0 | 41.5 |
| Boiled 20 minutes | 52.7 | 45.5 | 38.8 |
| Boiled 2 hours | 43.9 | 43.7 | 18.1 |

## Summary and Conclusions

The amount of vitamin C initially present in turnip greens has very little effect on the amount of vitamin C retained in cooked greens. Three methods of cooking were used: pressure cooking, short time boiling in a small amount of water and long time boiling in a large amount of water. The greatest yield of cooked greens is obtained with the short time boiling method. However, from the standpoint of nutritive value, the pressure cooked greens retain the largest quantity of vitamin C and, therefore, provide the greatest percentage of the daily allowance of vitamin C per serving.

Recommendation as to the preferred method of preparation must take into consideration whether some, none, or all of the cooking liquor is used in other food preparations. If all of the cooking water is consumed, there is little preference in preparation method. However, when large amounts of water are used for cooking the greens, there is a greater likelihood that at least a portion of the cooking liquor will be discarded. Since the use of long time cooking methods results in the largest quantity of vitamin C being extracted into the liquor, this method is considered to be the poorest method of preparation.

If none of the cooking liquor is used in other food preparations, pressure cooking is the recommended method of preparation of turnip greens.

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BULLETIN 655 JANUARY 1963

# Crop and Fertilizer Recommendations For Mississippi

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STATE COLLEGE MISSISSIPPI

# CROP AND FERTILIZER RECOMMENDATIONS FOR MISSISSIPPI

At timely intervals the Mississippi Agricultural Experiment Station issues crop and fertilizer recommendations based on the latest research findings at State College and ten Branch Experiment Stations in the State. Included is information on fertilization, varieties, and rates of seeding for crops generally grown in Mississippi as well as information pertaining to lawns, turf grasses and home gardens.

Because of varying soil and weather conditions and other local factors, no single crop variety or fertilizer will fit the entire state perfectly; nonetheless, these general recommendations are useful guides to crop production. Of course, these recommendations assume that other good farming practices will be followed.

Details and qualifications are omitted in most cases; if you need information on any crop you may obtain it from the Extension Service, the Experiment Station, your County Agent, or other trained agricultural workers in your locality.

### Soil Testing Service

The farmer realizes maximum profits from his fertilizer dollar only when the right kind and amount of fertilizers are used on each field. Through the Mississippi State Soil Testing Service every farmer can get detailed information about how much and what kind of fertilizer and lime to apply to each field. Furthermore, the Soil Testing Service makes fertilizer and lime recommendations for exceptionally high production goals and for contest fields which are not provided for in the general recommendations.

Soil testing is a free service. Soil sample boxes, mailing cartons, and instructions for collecting samples are available in each county agent's office and the offices of other agricultural agencies.

### Plant Nutrients

Plant nutrients can be divided into two groups: (1) Those elements used by crops in relatively large amounts; and (2) those needed in very small amounts.

**The first group** includes nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. The first three of these are usually called the "fertilizer nutrients" and are often applied to crops either as straight materials or mixed fertilizers. Straight materials are those which contain only one fertilizer nutrient. Some examples of straight materials are listed below:

| Material | Total Nitrogen (N) |
|---|---|
| Ammonium nitrate | 33 1/3% |
| Anhydrous ammonia | 82% |
| Nitrate of soda | 16% |
| | **Available Phosphate ($P_2O_5$)** |
| Superphosphate | 18 to 20% |
| | **Available Potash ($K_2O$)** |
| Muriate of potash | 60% |

Mixed fertilizers contain two or more of the fertilizer nutrients, and each fertilizer bag is stamped with a set of numbers to show how much plant food it contains. The first number always shows the percentage nitrogen (N), the second represents the percentage available phosphate ($P_2O_5$), and the third shows percentage water-soluble potash ($K_2O$). One hundred pounds of a 5-10-10 fertilizer thus contains 5 lbs. of total N, 10 lbs. of available $P_2O_5$, and 10 lbs of available $K_2O$. The fertilizer **ratio** refers to the relative amounts of these nutrients. The fertilizer **grade** gives the specific amounts of each fertilizer nutrient it contains. For example, 8-8-8 and 10-10-10 are two different grades in a 1-1-1 ratio. Similarly, 6-8-8 and 9-12-12 are two grades in a 3-4-4 ratio.

For the most part fertilizer recommendations are given in this circular as pounds of N, $P_2O_5$, and $K_2O$ needed per acre. Usually the farmer will have a choice of more than one fertilizer grade. For example, 48 lbs. N, 48 lbs. $P_2O_5$, and 48 lbs. $K_2O$ may be supplied with 600 lbs. of 8-8-8 or 400 lbs. of 12-12-12. Cost per unit of fertilizer and ease of handling should determine form and grade used. Since small deviations from the general recommendation will not affect profits significantly, it is not necessary to apply exactly the amounts of N, $P_2O_5$, or $K_2O$ called for. If, in the case described above, only a 10-10-10 were available, the farmer should use 500 lbs. per acre thus giving a total of 50 lbs. of each nutrient.

Liquid mixed fertilizers were introduced into Mississippi recently and have been thoroughly tested by the Agricultural Experiment Station. Results of these tests show that pound for pound of fertilizer nutrient, liquid fertilizers are just as effective as solid fertilizers. According to state laws, liquid fertilizers must meet the same specifications as solid fertilizers.

Calcium is usually applied to crops as agricultural limestone although the primary purpose of liming soils is to correct soil acidity by raising the pH. A more complete discussion of lime and liming is found elsewhere in this article. Magnesium may also be supplied in "dolomitic" limestone or, on soils needing magnesium but not requiring lime, as a soluble source of magnesium such as Sul-Po-Mag. Magnesium deficiences have been found so far only in parts of the Black Land Area of Mississippi.

Sulphur is an incidental component of superphosphate and is also contained in ammonium sulfate; therefore, when these materials (or mixed fertilizers formulated from these materials) are applied, sulfur is also added to the soil. However, changes in fertilizer technology have made possible the manufacture of fertilizer materials and mixtures containing very little sulfur. Research has shown that deficiencies are likely to occur on soils of the Hill Section when sulfur is omitted from the fertilizer program. Instances of deficiency have also occurred in the Delta. Sulfur deficiencies have been associated with land leveling in some cases, but they are not restricted to the areas which have been leveled. Sulfur deficiencies can be corrected by applying gypsum or by using superphosphate, ammonium sulfate, or mixed fertilizers that contain sulfur.

The **second group** of nutrients is called "trace" or "minor elements" or "micronutrients" because they are needed by crops in very small amounts. Included are zinc, boron, iron, maganese, copper, and molybdenum. Except for boron on alfalfa and for seed production of such legumes as white and crimson clover, zinc under tung and pecan trees, and boron on cotton in the Hill Section, minor element deficiencies are not wide-spread in Mississippi. Of course, small isolated problem areas may exist throughout the state. For advice about suspected minor element problems, the farmer should contact his County Agent.

### Soil pH and Liming

Excess soil acidity or a deficiency of lime reduces crop yields. A recent survey made by the Mississippi Soil Testing Laboratory showed that 68 percent of the soils tested needed lime.

The degree of acidity or alkalinity of a soil is expressed by the pH scale; values below 7.0 indicate an acid soil, above 7.0 an alkaline soil. Soil reaction, or pH, affects the availability of some of the more important plant nutrients in the soil. Phosphate is much less available in very acid soils than in slightly acid to mildly alkaline soils. In very strongly acid soils, (pH below 5.0) certain elements such as manganese and aluminum are changed to available forms in such quantities as to become toxic to plants.

Essential plant nutrients such as iron, manganese, boron, and zinc rapidly become less available as the pH of the soil increases above 7.0. This is one reason why one must not overlime. Experience has shown that overliming injury in Mississippi is very likely to be associated with deficiencies of boron and zinc. In the case of cotton and legumes, it is very likely to be due to boron deficiency and with corn, and perhaps others grasses, to zinc deficiency.

It has been found that soils with a pH of 6.0 or higher are well supplied with lime and at the same time maintain the other nutrients in forms sufficiently available to crops. If the pH is less than 5.0, the soil is very strongly acid and is extremely deficient in lime. Most non-legumes grow best if the soil pH is not allowed to drop much below 5.5 while most legumes do best if the pH is maintained above 5.5. Alfalfa grows best at soil pH values above 6.0.

The amount of lime required to raise the pH of the soil to a desired value depends on both the initial pH and the lime holding capacity of the soil. On soils of Mississippi having a pH of 5.5 or slightly below, the application of 3000 pounds of lime per acre to sandy loam and loam soils, 5000 pounds to silt loam soils, and 7000 to 9000 pounds to clay loam and clay soils has been found to give satisfactory results in correcting lime deficiency for legumes. Since about two-thirds of the soils of the state have natural pH values of 5.5 or above, application of the above rates of lime would bring or maintain the pH of a large majority of the soils within the range that is very favorable for legumes. But where such a program is followed, too much lime will be added to some soils and not enough to others. For example, the black upland soils and the bottom soils of the Northeast Blackland area seldom need lime even for legumes. A better practice would be to initiate a soil testing program on each farm and sample each field at least once in five years. Whenever the soil pH drops to an unfavorable level, the Soil Testing Laboratory will make specific recommendations as to the amounts of lime required.

It is a better practice to mix lime thoroughly with the top five to six inches of the soil, but depending on the texture 1000 to 2000 pounds may be applied as a surface application to permanent pastures, or other permanent sods.

Lime is naturally lost from the soil by crop removal and by leaching. The use of acid forming sources of nitrogen and the turning under of legumes as soil builders accelerate these losses. For example, 100 pounds of nitrogen from such sources as ammonium nitrate, anhydrous ammonia and urea will cause the loss of calcium and other bases equal to about 200 pounds of lime. When applied annually at this rate, the loss would amount to one ton of lime every ten years due to fertilizer alone. This, together with natural losses indicates that soils require lime at periodic intervals.

Generally, on sandy loam, loam, and silt loam soils a maintenance application of one ton of lime per acre once every 5 to 7 years will be reqiured for legumes and for non-legumes fertilized with nitrogen as recommended. On clay loam and clay soils less frequent but larger applications may be made. Although lime may be needed badly on some soils for non-legumes, the deficiency is not sufficiently general to warrant a recommendation for its general use to raise the soil pH values to a more favorable range but maintenance applications should be made as indicated before to prevent more soils becoming deficient. Areas going into permanent grass sod should receive the initial maintenance application of lime prior to establishment. Subsequent maintenance applications may be applied to the surface.

The principal liming materials available in Mississippi are ground calcic and dolomitic limestones, crushed chalk or marl from Mississippi deposits and basic slag. Calcic limestones contain calcium carbonate while dolomitic limestones contain both calcium and magnesium carbonates. Liming materials from Mississippi deposits contain calcium carbonate only. Basic slag, a materials containing a minimum of 8 percent $P_2O_5$ and the equivalent of about 75 percent lime is priced largely on the basis of its phosphate content, and should be used only where both the lime and phosphate are needed. The cost for its use as a liming material only is prohibitive.

Research has shown that all these materials are very effective in neutralizing soil acidity providing the calcic and dolomitic limestones have been finely ground. Particles not passing a 40-mesh screen (40 holes per linear inch) are not very effective in neutralizing soil acidity. For this reason 90 to 100% of calcic and dolomitic limestones should pass a 10-mesh screen and 50% a 100-mesh screen. Particle size is not as important in the case of the Mississippi liming materials which contain clay as an impurity which causes the particles to break down so that they react with the soil. They must be crushed finely enough however, so that they can be spread uniformly.

Generally, the Delta and Deep Loess soil areas are abundantly supplied with magnesium and a calcic lime will be satisfactory. In the other soil areas of the state, magnesium levels tend to be lower and a liming material containing considerable magnesium, such as dolomitic lime, should be used, particularly in the Northeast Blacklands.

### Fertilizer Efficiency

In crop production the primary objective of using fertilizers is to increase the net profit per acre. The rate of fertilizer required for maximum profit per acre depends on may factors. Some of the more important ones are: (1) crop, (2) soil and fertilizer characteristics, (3) time and method of application of fertilizer, (4) degree of insect, disease, and weed control, (5) weather, (6) tillage practices, and (7) increase in yield, together with the ratio of costs to returns from fertilizer. Under a given set of circumstances, the efficiency of utilization of fertilizer by a crop may be greatly affected by time and/or method of application.

### Time of Application

In general fertilizer nutrients are reduced in effectiveness following their application to the soil because of loss by leaching and conversion to less available or to unavailable forms.

Fertilizers may contain nitrongen in the form of nitrate or ammonium, or both, or in other forms (urea and cyanamide) that are changed rather rapidly to ammonium when applied to the soil. Nitrate salts found in fertilizers and in soils are highly soluble in water and since they are not retained by combining with the soil, they are easily leached from the root zone, particularly on sandy loam, loam, and silt loam soils or other soils where water percolates easily through the soil profile. Under water-logged conditions nitrates in soils may be changed by soil organisms (denitrification) to gaseous nitrogen which escapes into the atmosphere. Ammonium nitrogen is not denitrified; neither is it easily lost by leaching because it combines chemically with the clay and organic matter. However, it is soon converted by soil bacteria to nitrate salts which may be lost as just indicated.

Thus, it is evident that nitrogeneous fertilizers are not retained in soils of Mississippi for long periods, and accordingly, maximum efficiency for crop production is generally obtained by applying the nitrogen at or near the beginning or during the growing season.

Phosphate fertilizers are not lost from soils by leaching, but their availability to plants is reduced, particularly in acid soils, because they react rather rapidly with iron and aluminum to form phosphates that are much less available to plants. The reactions are referred to as "phosphate fixation." Because of this fixation, annual, seasonal applications of phosphate, are better than less frequent or off-season applications. This is true for both annual and perennial crops. In general, best results are obtained by applying phosphate fertilizers at or just prior to seeding, or near the beginning of the growing period in the case of maintenance applications to perennial crops.

The effectiveness of potassic fertilizers is not reduced appreciably by fixation as is phosphate, nor is the potassium as easily leached from soils as nitrate. However, on sandy loam, loam, and silt loam soils the extent of loss by leaching is such that annual, seasonal applications are better than less frequent applications. Also, with harvested forage crops excessive uptake (luxury consumption) and removal of the potash in the harvested portion makes annual, and sometime split, seasonal applications necessary even where the potash would not be lost by leaching. This is especially true where multiple harvests of forage crops like alfalfa, which are very heavy users of potash, are made.

Fall or winter plowing to prepare a seed bed is highly desirable, if not essential, for successful row-crop production on heavy clay soils. Where equipment is not available for proper placement of fertilizer in a prepared seed bed in the spring, the phosphate, and potash, and magnesium where recommended should be applied at the time the seed bed is pre pared. The method of application should be such that the location with respect to the seed row will be in conformity with the recommendations for the crop in question. Except for the black clay upland soils and the clay bottom soils of the Northeast Blackland Area, or other clay soils known to be either slightly acid or alkaline in reaction, the recommended rate of phosphate should be increased by about 50 percent when applied in the fall or winter.

From the foregoing observations it is evident that the soil, fertilizer and crop characteristics must be taken into account in order to time the application of fertilizer so that maximum availability to and need by the crop are made to coincide in so far as it is practical to do so. This is reflected in the recommendations given later.

### Method of Application

In selecting a method for applying fertilizer, there are two factors of availability that must be considered: namely, positional and chemical.

Chemical availability refers to the capacity of the fertilizer to supply nutrients to plants. The chemical availability of phosphatic fertilizers is greatly affected by the method of application, particularly on acid soils. Banding water-soluble and other highly reactive phosphates as opposed to broadcasting and mixing them with the soil greatly increases their chemical availability because of reduced contact with the soil which in turn slows up the process of phosphate fixation. When coupled with proper placement with respect to the seed row of drill-seeded and row crops, the effectiveness of the phosphate sometimes is doubled. The chemical availability of potassic and nitrogeneous fertilizers is not so greatly affected by degree of contact with the soil, thus banding as opposed to broadcasting is of little advantage in this respect.

Positional availability refers to the location of the fertilizer with respect to the plant roots. For example, fertilizer placed in the soil a foot or so from the row is positionally unavailable to plants in the seedling stage.

Phosphatic and potassic fertilizers applied to the surface do not penetrate the soil to a very great depth. If applied in this way to row crops, they may remain positionally unavailable throughout the growing season because cultivation disturbs the soil, and plant roots do not persist in the surface inch or so where the fertilizers are held, particularly the phosphate. Also, nitrogenous fertilizers applied to the surface of the soil, particularly when dry, remain unavailable for the most part until dissolved and moved down into the root zone by percolating water. On most soils before ammonium sources of nitrogen are moved down into the root zone to any appreciable extent the ammonium must first be changed by soil bacteria to nitrate (nitrified), a process which usually reqiures 2 to 4 weeks for completion in moist soil during the spring and summer. If the nitrogen is applied far enough in advance for the necessary transformation and movement into the root zone to occur by the time it is needed by the crop, positional unavailability is avoided. Surface application of fertilizer is more effective with sod crops than with row crops except during periods of drought because plant roots develop and persist near the surface; in fact, this method is so effective that it is recommended for applying maintenance fertilizers to perennial, close-growing crops.

To be readily available to the seedling, the fertilizer must be placed relatively close to the seed, usually to the side of and below so that the fertilizer is contacted by the secondary roots soon after they have begun to develop. The fertilizer should be deep enough to be in moist soil most of the time during the growing season. On the other hand, to avoid salt injury to the germinating seeds and to the seedlings, care must be taken not to place the fertilizer too close to the seed, or in such a position that salts in excessive amounts may move in around the seed or seedling. Since the fertilizer salts in solution move upward or downward with soil water and to some extent laterally by diffusion, the fertilizer should be placed to the side of the seedrow, the distance depending on the kind and rate of application.

Nitrogen and potassium salts are largely responsible for salt injury due to improper placement of fertilizer. Unless they are drilled together in the same band, phosphatic fertilizers and the seed are not likely to come in contact with each other because the phosphate will not move far enough from the fertilizer band to contact the seed before reacting with the soil to become relatively insoluble in water and, thus, immobile.

With row crops and most drill-seeded crops both chemical and positional availability during the growing season are maximized and injurious concentrations of salts around the seeds or seedlings are avoided by placing the fertilizer in narrow bands at least two inches to the side of and two inches below the seed. The minimum separation may be employed with recommended rates of phosphate and potash and up to 40 pounds of nitrogen per acre. With higher rates of nitrogen and potash both the vertical and horizontal distances between the seed and fertilizer should be increased.

Although contact placement of seed and fertilizer should be avoided with most crops and is not the preferred practice in this case, recommended amounts of phosphate and a combined total of 50 pounds of potash plus nitrogen may be drilled with small grain or grass seeds without appreciable injury in most cases when drills are spaced no more than 10 inches apart. Higher rates of fertilizer, particularly of potash and nitrogen, should be placed two inches or so below and to the side of the seed.

Supplementary nitrogen applied to small grains or other winter-growing crops in solid form or as non-pressure solutions may be broadcast or sprayed on the surface of the soil with satisfactory results. However, this may not be the case with urea or urea-ammonium nitrate solutions when applied in the late spring, summer, or early fall. When in contact with the soil or decomposing plant residues the nitrogen in urea is changed rapidly to ammonium by the action of the enzyme urease. This reaction proceeds much more rapidly in warm than in cold weather and in warm seasons is likely to occur to such an extent before the urea comes in contact with enough soil to react with and retain the ammonium that a significant amount of the nitrogen is lost as gaseous ammonia. This is more likely to occur on sandy or sandy loam than on other soils because they have a very low capacity to retain ammonium.

## Recommendations for Major Field Crops

### CORN

Hybrids are listed alphabtically in area of adaptation.

**North Mississippi:** (north of U. S. Highway 82). White: Dixie 29, Dixie 55, Dixie 77. Yellow: Dixie 22, Funk's G-710AA, Funk's G-711AA, McCurdy 999, Pioneer 309B.

**Central Mississippi:** (north of U. S. Highway 80 and south of U. S. 82). White: Dixie 55, Coker 911. Yellow: Dixie 18 (southern), Dixie 22 (northern), Dixie 82, Coker 67, Funk's G-720, Funk's G-730, McCurdy 1003C, N. C. 288, Pioneer 309B.

**South Mississippi:** (south of U. S. Highway 80). White: Dixie 55 (early corn), Coker 811. Yellow: Dixie 18, Coker 67, Coker 71, DeKalb 1225, Funk's G-740.

**Silage Corn:** Any full season hybrid recommended for your area having high grain yield and lodging resistance.

**Land Preparation:** Prepare a good seedbed on reasonably deep well-drained soil. Avoid steep, droughty, and eroded hillsides. Plant in South Mississippi from March 20 to April 10, in Central Mississippi from April 1 to April 15, and in North Mississippi from April 10 to April 25. Space plants 10-15 inches apart in rows 42 inches wide, or 12-16 inches apart in 40-inch rows, depending on soil fertility and expected rainfall.

**Fertilization, Hill and Delta Foothill Section.** For the soils of this section a complete fertilizer is generally needed, and this should be supplmented by a side dressing application of additional nitrogen. When corn is grown successively for silage on a field for more than 3 years the fertilizer rates given below should be increased as follows: Nitrogen, 100 to 130; phosphate, 50, potash 100 pounds per acre.

**Time:** Apply the complete fertilizer at planting time. Supplemental nitrogen should be side-dressed by the time the corn is knee high. Timing of the side dressing is especially important as delay much beyond the knee-high stage may result in reduced yields.

**Rate:** The planting - time fertilizer should supply approximately 36 pounds each of N, $P_2O_5$, and $K_2O$. Optimum rates of $P_2O_5$ and $K_2O$ will vary with soil type and past history of fertilization; more specific recommendation may be obtaind by having soils analyzed by the Soil Testing Laboratory. The side dressing application should supply 60 to 90 pounds of nitrogen per acre.

**Method:** Apply the planting-time fertilizer at least 2 inches to the side and 2 inches below the level of the seed. This placement may be obtained by attachments on the corn planter. If such attachments are not available the equipment at hand should be used to give this approximate relation between seed and fertilizer.

**Fertilization, Delta Section: Time:** Nitrogen may be applied at or prior to planting or in split applications, one-half at or before planting and the rest as a side-dressing before the corn is knee high.

**Rate:** 120 pounds of nitrogen per acre.

**Method:** Place preplant and planting time applications of nitrogen 4 to 6 inches from the drill row, non-pressure solutions and solid sources at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 or more inches below the level of the seed. Place side-dress applications of nitrogen 1 foot or more from the row, non-pressure solutions and solid sources at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 inches.

### Cotton in the Hill Sections

**Varieties:** Auburn 56, Plains, Coker 100 A, Dixie King, Rex, Stoneville 3202, Deltapine Smooth Leaf, and Fox 4.

For soils infected with Fusarium Wilt —Auburn 56, Plains, Coker 100 A, Empire, Dixie King, and Rex.

Some new varieties which have looked good in the one to three years they have been tested are Empire 61WR, Stoneville 7A, Stoneville 213, Delta Queen, Carolina Queen, DeKalb 108, and DeKalb 220. Of these, DeKalb 108, Empire 61WR, and Delta Queen and Carolina Queen have resistance to Fusarium wilt.

**Seeding Dates and Rates:** Plant between April 10 and May 10 as weather permits. Hill dropped—16 to 22 pounds of delinted seed per acre. Drilled—20 to 30 pounds of delinted seed per acre. For undelinted seed increase rates by 10 to 15 pounds per acre. Seed should be of good viability.

**Fertilization:** A complete fertilizer containing sulfur and boron generally is needed for cotton in the Hill Sections. In addition, the fertilizer for cotton on black and brown or brownish black soils of the northeast Blackland Area should contain enough magnesium in water-soluble form to supply at least one-half and preferably as much magnesia as potash. On soils known to have a pH of 6.0 or below dolomitic lime may be used as a source of magnesium if it is broadcast and mixed with the soil at the rate of one to two tons per acre. An application of two tons per acre will supply enough magnesium for ten or more years.

Adequate boron is provided when the mixed fertilizer contains 0.3 lb of boron for each 48 pounds of phosphate ($P_2O_5$), or a phosphate to boron ratio of 160:1. No more than 0.5 pounds of water-soluble boron per acre should be drilled with the fertilizer in close proximity to the seed.

Under natural soil conditions cotton grows well within the pH range of 5.5 to 7.5 but acid soils should not be limed to raise the pH above 7.0. For liming recommendations see sections on Soil pH and Liming.

**Time:** Apply the phosphate and potash along with all or part of the nitrogen in the spring at or prior to planting with any supplemental nitrogen being applied as a side dressing by mid-June—one to two weeks earlier if anhydrous ammonia is used. Nitrogen sources having as much as one-half of the nitrogen in the nitrate form usually are more efficient on sandy loam, loam and silt loam soils if one-half to two-thirds of the nitrogen is applied as a side dressing but with other sources there is no particular advantage in splitting the application except on deep, excessively drained sandy or sandy loam soils.

Fall or winter plowing to prepare a seed bed is highly desirable if not essential for successful cotton production on heavy clay soils. See section on Fertilizer Efficiency with regard to time of application of fertilizer to clay soils.

**Rate:** Apply 72 pounds of nitrogen (N), 48 pounds of phosphate ($P_2O_5$) and 48 pounds of potash ($K_2O$) per acre except as follows: Increase the rate of fertilizer to about 110 pounds of nitrogen and 60 pounds each of $P_2O_5$ and $K_2O$ on the blackish and brownish, upland soils of the Northeast Blackland Area and to about 90 pounds of nitrogen per acre on the well-drained and bench-land soils of the Upper Coastal Plain and Northeast Blackland Areas.

On soils of light texture an application of as much as 144 pounds of nitrogen per acre frequently gives a slightly lower yield than the recommended rate and sometimes there is a marked reduction. Too much nitrogen reduces yields because it causes excessive vegetative growth, delays fruiting and increases the risk of shedding due to drought, and makes it more difficult to control insects. The likelihood of boll rot also is increased.

**Method:** Place complete fertilizers that supply up to one-half of the recommended nitrogen in narrow bands 2 to 3 inches to the side of and 2 to 3 inches below the cotton seed. With higher rates of fertilizer, particularly nitrogen and potash, increase both the vertical and horizontal separation of seed and fertilizer. Avoid contact placement of seed and fertilizer as well as shallow placement even of low rates of nitrogen or potassium containing fertilizers directly beneath the seed. Preplant and planting-time applications of anhydrous ammonia should be placed so as to be 4 to 6 inches to the side of and 4 to 6 inches below the seed. Where weeds and grass are not a problem, broadcasting solid sources or spraying non-pressure nitrogen solutions on the surface is about as effective as other methods of application at planting time.

Place side-dressing nitrogen in the edge of the root zone, usually a foot or so from the row, non-pressure solutions and solid sources 3 to 4 inches deep and anhydrous ammonia 6 inches deep.

### Cotton in the Delta

**Varieties:** Auburn 56, Coker 100A, Delta Queen, Delfos 9169, Deltapine 15, Deltapine Smooth Leaf, Dixie King, Fox 4, Rex, Stoneville 7A, Stoneville 3202, Stoneville 213[1], and DeKalb 220[1].

For wilt land (Fusarium wilt), Auburn 56, Coker 100A (WR), Dixie King, Empire WR, and Rex.

**Seeding Dates and Rates:** Plant as soon after April 1, as weather permits, but not in cold soil. Hill dropped—16 to 22 pounds of well delinted seed per acre. Drilled—30 to 40 pounds of well delinted seed per acre. Drilled for cross plowing —60 pounds of delinted seed per acre. Seed should be of good viability.

**Fertilization:** Delta soils generally need nitrogen fertilizer only for most profitable production, but in the foothills area, the use of phosphate and potash frequently may be profitable. Lime should be used to maintain the soil pH between 5.5 and 7.0

**Time:** Apply nitrogen in the spring at or prior to planting except that on sandy loam soils having very good to excessive internal drainage one-half of the nitrogen should be side-dressed by mid-June.

**Rate:** Sandy loam, loam, and silt loam soils, 90 to 100 pounds of nitrogen per acre. Clay, silty clay, and clay soils, 100 to 120 pounds of nitrogen per acre.

**Method:** Place preplant and planting-time applications of nitrogen 4 to 6 inches from the drill row, non-pressure solutions and solid sources of nitrogen at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 to 8 inches below the level of the seed. Place side-dressing applications of nitrogen 1 foot or more from the row, non-pressure solutions and solid sources at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 inches.

### Rice in the Delta

**Varieties:** Bluebonnet 50, Century Patna 231, Nato, Zenith, and Gulfrose.

**Seeding Dates and Rates:** Rice can be seeded from mid-April to mid-June. The seeding rate should be 90 to 110 pounds per acre if drilled, and 120 to 125 pounds per acre if broadcast.

**Fertilization:** Phosphate and potash fertilizers generally are not required for the heavy clay soils devoted to rice production in the Mississippi Delta. Nitrogen is recommended except where rice is to be planted on newly cleared land. Nitrogen should be applied at the rate of 60 to 100 pounds per acre depending on previous cropping history. Excessive nitrogen causes lodging and should be avoided. On land relatively free of grasses, the nitrogen may be applied at planting or before the first watering. On fields known to have a grass problem, application of nitrogen should be delayed for 7 to 9 weeks after seeding, at which time the field should be drained and allowed to dry prior to applying the nitrogen.

Ammonium and urea sources of nitrogen have been more effective than nitrate sources for rice production.

### Soybeans

**Varieties:** Hill, maturing in last half of September; Hood, maturing in early October; Lee, maturing in mid-October; and Jackson, maturing in late October. Lee should be grown as the major bean variety in all areas except deep South Mississippi, where Jackson should be given preference. Hill and Hood are well suited for production in the Delta area to supplement Lee and permit earlier harvest on land reasonably free from weeds.

**Soils:** Soybeans are adapted to all Delta soils and to the more productive soils of the Hill Sections, such as good bottom and bench-land soils. They will not produce satisfactory yields on eroded, droughty upland soils.

**Seeding Dates and Rates:** May 1 to June 1 except extreme South Mississippi June 10 to June 20. Plant 10 to 12 viable seed per foot of row. Where planted in 36 to 40 inch rows, this will requrie 40 to 50 pounds of good quality seed per acre.

**Fertilization:** Soybeans require no fertilizer on most Delta soils. Outside the Delta, fertilizer is usually necessary for satisfactory production and lime is needed on soils having a pH below 6.0. A soil test will suggest the fertilizer and lime needs. Good response can usually be expected from applications of 30 pounds of phosphate ($P_2O_5$) and 60 pounds of potash ($K_2O$) per acre. Fertilizer should be applied as a band 2 to 3 inches to the side and 2 to 3 inches below the seed. Avoid contact placement of seed and fertilizer as well as placement directly beneath the seed.

**Inoculation:** If not on land where a crop of well nodulated soybeans has grown within the last five years, the seed should be inoculated. There are some indications that molybdenum may be needed on soils having a pH below 6.0.

### Sorgo for Sirup and Silage

**Varieties** Wiley for sirup — matures in late September. Tracy and Sart are best for silage. Tracy matures in late August to early September and Sart in late September, or in October. Sart outyields Tracy. Honey (Texas seeded ribbon cane) yields well under favorable conditions but is more susceptible to disease and lodges badly; when diseased, the sugar content is too low for good silage. Harvest sorghum in the dough stage for silage and in the late dough stage for sirup.

**Seeding Dates and Rates:** April 20 to May 20. If seeded in hills 24 inches apart, plant 1½ to 2 pounds of seed per acre and if drilled, 3 to 5 pounds per acre. A good stand is 3 to 4 plants per 2 feet of row whether arranged singly or in groups. Thicker spacing results in smaller stalks that are more likely to lodge as well as being more trouble to strip for sirup.

**Fertilization:** Apply 40 pounds of nitrogen (N), phosphate ($P_2O_5$) and potash ($K_2O$) per acre at planting time.

Place the fertilizer in a band 2 to 3 inches to the side and 2 to 3 inches below the level of the seed. Except on fertile bottom soils, side-dress with about 30 pounds of nitrogen per acre by the time the plants are knee high. See Section on Corn for suggestions as to placement of side-dressing nitrogen. Higher rates of nitrogen increase the likelihood of lodging. If sorghum is to be grown successively for silage on a field for more than three years, the potash should be increased to at least 80 pounds per acre.

In the Delta Area apply 60 to 80 pounds of nitrogen per acre at or prior to planting. Phosphate and potash generally are not needed in this area.

### Sugarcane for Sirup

**Varieties:** C. P. 36-111. On deep, well drained soils of light texture.

**Seeding Dates and Rates:** Cut seed cane at the top mature joint and at ground level, but do not strip before planting. Plant in the fall (October 15) at the rate of 2 stalks, that is, place stalks end to end with a whole stalk at the union. Plant the cane in 4-foot rows on land that has been broken 5 to 6 inches deep a few weeks earlier. To protect from cold and to provide good drainage, cover the cane 6 to 8 inches deep by forming a ridge over it so that the drainage furrows between the rows are 2 to 4 inches deeper than the cane.

**Fertilization:** In the spring apply 40 to 50 pounds each of nitrogen and phosphate ($P_2O_5$) and potash ($K_2O$) per acre shortly after germination of the eyes, or just before re-growth from the stubble. Place the fertilizer in a band so that it will be 4 to 6 inches to the side of the row and 3 to 5 inches deep after the ridges have been worked down, or 1 to 2 inches deeper than the cane. Side dress with about 30 pounds of nitrogen per acre before July. Place side-dressing nitrogen in the edge of the root zone deep enough to be in moist soil without being disturbed by subsequent cultivation

Strip, top, and cut the cane before freezing weather. Harvesting as much as a month before processing improves sirup quality and reduces "sugaring".

## Grasses, Legumes, and Small Grains

(See Tables on next 6 pages)

**Supplementary Information on Pasture Recommendations for the Hill Section**

If equipment is available drill or row placement of seed and fertilizer is recommended for the establishment of all pasture and forage crops. With small seeded legumes and grasses care must be taken not to seed too deep. For established pastures, solid fertilizers should be topdressed.

Where conditions are especially favorable for legumes, the danger of bloat may prevent full utilization of legumes seeded alone or of grass-legume combinations such as Dallisgrass and white clover, particularly in the Deep Loess area. The drilling of small grains or ryegrass into such a pasture will lessen the bloat problem and supply additional forage.

Because of the wide variety of soils to which these pasture recommendations will be applied, and of the extensive nature of the typical commercial livestock operation in Mississippi, particularly beef cattle, the pasture fertilizer recommendations are generally presented as a range instead of a single and more arbitrary figure.

The lower limit of the recommendation is estimated to be sufficient for plant establishment and (1) for reasonable yields of forage on soils well adapted to the particular pasture crop under consideration, (2) for periods of economic stress during which it is still necessary to maintain a reasonable supply of cheap forage, and (3) where acreage per animal unit is not a serious limiting factor.

The upper limit of the fertilizer recommendations continues to be the agronomic optimum and should be used where the (1) soil type, (2) management system, (3) type of livestock enterprise, and (4) economic trend are such as to justify the considerably higher yields of forage that result from its use.

For winter growing grass-legume combinations, the amount of nitrogen used and the time of application depend primarily upon when grazing is needed and upon the desired proportion of grass and legume. Although there is very little difference in the total season's production of forage, fall applications speed plant establishment, increase fall and winter yields, and tend to provide a more favorable grass-legume ratio. For milking cows, lambs and other classes of livestock or system of managements where fall and winter grazing is important, and where danger of bloat exists, the application of 30-60 lbs. N at planting time is recommended.

The yields of grass forages is greatly increased by the application of nitrogen and where weather conditions do not limit growth excellent response is obtained to high rates of nitrogen; therefore, the most economical rate will depend upon temperature, availability of moisture, and the use made of the additional forage.

To increase the utilization of the nitrogen or to obtain a more favorable distribution of pasture production, split applications of nitrogen are recommended for both summer and winter grass pastures, with 30 to 60 pounds being applied each time. Except for coastal bermudagrass where the last application may be as late as September 1, the last application of nitrogen to permanent summer pastures should be made no later than August 1, and two weeks earlier if anhydrous ammonia is used. Because of the increased frequency of drought, midsummer applications of nitrogen are generally less effective than applications made in the spring and early summer. For this reason more nitrogen should be applied in the spring than in summer season.

If irrigated, it may be economical to apply 120 pounds of nitrogen per acre to millet and sudangrass; 200 pounds to common Bermudagrass, Dallisgrass, and Bahiagrass, and 400 pounds to Coastal Bermudagrass pastures.

For summer temporary grazing crops, best response is obtained from nitrogen applied 4 to 5 inches deep whether before planting or as a side dressing. Surface applications followed by dry weather may be of little value.

For winter growing grass or grass-legume pastures that are seeded late and from which no fall or winter grazing can be expected, the initial nitrogen application may be delayed until growing conditions are more favorable.

Fall application of phosphorus or potash is recommended if these nutrients are necessary to establish forage seedlings in the fall. However, spring application is more effective for spring and summer growth of perennial plants and those which come up in the spring. In general, fertilizers should be applied as close as practical to the time they are to be used by plants.

## RECOMMENDATIONS FOR PASTURE, FORAGE AND GRAIN CROPS IN HILL SECTIONS****

| Pasture Crop | Recommended Varieties | Time of Planting | Rate of Seeding per Acre | Fertilization, lbs./A annual application except lime |
|---|---|---|---|---|
| | | **GRASS—LEGUME COMBINATIONS******* | | |
| Dallisgrass lespedeza | Dallisgrass; domestic or imported. Lespedeza: Kobe, common, climax | Dallisgrass: Feb.-Apr.; Aug.-Oct. Lespedeza: Feb.-Mar. | 10 lbs. Dallisgrass (live seed)<br>20 lbs. lespedeza | **Establishment:** 1 to 4 tons lime*, 60-100 lbs. $P_2O_5$, 40 to 60 lbs. $K_2O$.<br>**Maintenance:** 40 to 60 lbs. $P_2O_5$, 40-60 lbs. $K_2O$.** |
| Dallisgrass-clover | Dallisgrass: domestic or imported. White clover: Ladino, La. S-1, or other adapted strains | Dallisgrass: Feb.-Apr., Aug.-Oct. White clover: Sept. 1-Oct. 15 | 10 lbs. Dallisgrass (live seed)<br>2 lbs. white clover | Same as above |
| Ryegrass clover | Ryegrass:domestic, Italian American, Annual; Clover: Ladino, La. S-1, or other adapted strains—common and reseeding crimson | Sept. 1-Oct. 15 | 20-25 lbs. ryegrass<br>3 lbs. all varieties white clover, or 20-25 lbs. Crimson clover | 1 to 4 ton lime*, 0-60 lbs. N, 60 to 100 lbs. $P_2O_5$, 30 to 60 lbs. $K_2O$** |
| Small grain and clover | Small grain: oats, wheat, rye, barley. Clover—common and reseeding crimson | Sept. 1-Oct. 15 | 90 lbs. small grain;<br>20-25 lbs. all crimson clovers | Same as above |
| Tall Fescue & white clover | Tall fescue: Alta, Kentucky 31. White clover Ladino, La. S-1, or other adapted strains | Sept. 1-Oct. 15 | 3 lbs. clover<br>10 lbs. fescue | 1 to 4 tons lime*, 0-60 lbs. nitrogen (N) 60-100 lbs. phosphate ($P_2O_5$), 50 to 80 lbs. potash ($K_2O$)** |

## LEGUMES*****

| | | | | |
|---|---|---|---|---|
| Lespedeza | Kobe, Climax, common | Feb.-March | 25 lbs. | 1 to 4 tons lime*, 40 to 60 lbs. $P_2O_5$, 30 to 60 lbs. $K_2O$** |
| Lespedeza-sericea | | Feb.-July 1 | 30-35 lbs. (hulled) | Same as above |
| Austrian winter peas | | Sept. 1-Oct. 15 | 50 lbs. | Same as above |
| Rough peas | Also known as Wild Winter Peas, Caley peas, Singletary pea | Sept. 1-Oct. 15 | 50 lbs. | Same as above |
| Kudzu | | Between last frost & May 1 | 500-1000 crowns | Same as above |
| Vetch | Hairy | Sept. 1-Oct. 15 | 30 lbs. | Same as above |
| Crimson clover***** | Reseeding: Autauga, Chief Talladega, Dixie. Non-reseeding: Frontier, Common | Sept. 1-Oct. 15 | 20-30 lbs. | Same as above. For seed production add 5-10 lbs. borax |
| White Clover | Ladino, La. S-1, or other adapted strains | Sept. 1-Oct. 15 | 4 lbs. | Same as for Dallisgrass lespedeza except 5 to 10 lbs. of borax for seed. |
| Red Clover | Orbit, Port Gibson, Kenland | Sept. 1-Oct. 15 | 8-10 lbs. | **Establishment:** 1 to 4 tons lime*, 60 to 100 lbs. $P_2O_5$, 60 to 100 lbs. $K_2O$. For seed 5 to 10 lbs. borax.<br>**Maintenance:** 40 to 60 lbs. $P_2O_5$, 40 to 60 lbs. $K_2O$. For seed 5 to 10 lbs. borax.** |
| Alfalfa | Buffalo, Atlantic, Williamsburg, and Narragansett | Sept. 1-Oct. 15 | 20 lbs. per acre | **Establishment:** 1 to 4 tons lime*, 150-200 lbs. $P_2O_5$, 150 to 200 lbs. $K_2O$, 10 lbs. borax.<br>**Maintenance:** 60-100 lbs. $P_2O_5$, 120 to 200 lbs. $K_2O$, 10 lbs. borax.** |

RECOMMENDATIONS FOR PASTURE, FORAGE AND GRAIN CROPS IN HILL SECTIONS****—(Continued)

| Pasture Crop | Recommended Varieties | Time of Planting | Rate of Seeding per Acre | Fertilization, lbs./A annual application except lime |
|---|---|---|---|---|
| | | **WARM SEASON GRASSES** | | |
| Dallisgrass | Domestic, imported | Feb.-April: Aug.-Oct. | 10 lbs. (live seed) | Lime*. 60 to 120 lbs. N in split applications, 30 to 60 lbs. $P_2O_5$, 30 to 60 lbs. $K_2O$.** |
| Bahiagrass | Pensacola, Wilmington Tifhi | Feb.-April; or Aug.-Oct. | 15 lbs./A | Same as for Dallisgrass |
| Bermudagrass | Common | Feb.-May | 5 lbs. seed or one clump every three feet | Same as for Dallisgrass |
| | Coastal | Feb.-May | one clump every three feet | Lime*, 100 to 200 lbs. N, 50 to 70 lbs. $P_2O_5$, 50 to 70 lbs. $K_2O$**. |
| Millet | Pearl, Cattail<br>Starr, Gahi | Seeded by June 15 | 10 lbs. in rows,<br>25 lbs. broadcast | Same as for Dallisgrass |
| Sudan | Greenleaf, Tift, Sudox (SX11) Lindsey 77F, Grazer | Seeded by June 15 | 10 lbs. in rows,<br>25 lbs. broadcast | Same as for Dallisgrass |
| Grain Sorghum | Brown grain, open heads: AKS 614, GA 609, Red grain, compact or semi compact heads: RS 610, DeKalb E56A (open headed), P. A.G. 515S, AMAK R-10, NK 210, TE 66, Lindsey 788, Ranger, Kiowa, and others. | Apr. 25-July 15 | 6-9 seeds per foot of 33-40" row (6-9 lbs. per acre) | 60-90 lbs. nitrogen, 30 lbs. phosphate, 30 lbs. potash at planting time. |

## COOL SEASON GRASSES

| | | | | |
|---|---|---|---|---|
| Tall Fescue | Alta and Kentucky | Sept. 1-Oct. 15 | 10-15 lbs. | Lime* 60-150 lbs. of Nitrogen in split applications in fall & spring; 30-60 lbs. of $P_2O_5$; 30-60 lbs. of $K_2O$. |
| Rescuegrass | Lamont | Sept. 1-Oct. 15 | 30-40 lbs. | Same as for Tall Fescue |
| Ryegrass | Italian, Annual<br>Domestic, Gulf | Sept. 1-Oct. 15 | 20-30 lbs. | Lime* 90-200 lbs. of Nitrogen in split applications, 30-90 lbs. $P_2O_5$; 30-60 lbs. $K_20$. |
| Oats | NORTH MISSISSIPPI:<br>Delta Red 33, Nortex 107, Delair, Mid-South, Victorgrain 48-93*** Moregrain<br>SOUTH MISSISSIPPI:<br>Delta Red 88, Nortex 107, Camellia, Suregrain and Moregrain | For Forage:<br>Sept. 1-Oct. 1<br>For Grain:<br>Oct. 1-Oct. 15 | For Forage: 128 lbs. (4 bu.)<br>For Grain: 96 lbs. (3 bu.) | **FOR FORAGE:** Same as for Ryegrass<br>**FOR GRAIN:** 20 lbs. nitrogen, 20 lbs. phosphate and 40 lbs potash at seeding. Topdress with 40 lbs. nitrogen about March 1.** |
| Rye | Elbon<br>Explorer<br>(Gator and Florida Black South Miss. only) | Same as Oats<br>Same as Oats | For Forage: 90 lbs.<br>For Grain: 75 lbs. | **FOR FORAGE:** Lime*<br>Same as for Ryegrass<br>**FOR GRAIN:** Lime*<br>Same as for Oats |
| Wheat | NORTH & CENTRAL MISS.:<br>Anderson, Chancellor, Atlas 66, Coker 47-27, Bledsoe<br>SOUTH MISS.: Anderson<br>Atlas 66, Coastal, Bledsoe | Same as for Oats<br>Same as for Oats | For Forage 90 lbs.<br>For Grain: 75 lbs. | **FOR FORAGE:** Lime*<br>Same as for Ryegrass<br>**FOR GRAIN:** Lime*<br>Same as for Oats |
| Barley | NORTH & CENTRAL MISS.:<br>Kenbar, Pace, Dayton | Same as for Oats | For Forage 90 lbs.<br>For Grain: 75 lbs. | **FOR FORAGE:** Lime*<br>Same as for Ryegrass<br>**FOR GRAIN:** Lime*<br>Same as for Oats |

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*See section on soil pH and liming for recommendations as to rate of lime to apply to different soils and crops in the absence of a soil test or other knowledge of the lime statue of the soil.

**Or the appropriate quantity of any mixed fertilizer which contains this ratio of nitrogen (N), phosphate ($P_2O_5$) and potash ($K_2O$).

These oat varieties are susceptible to Victoria blight, and should not be planted too early in Central Mississippi unless the planting is made on land which has not grown oats for at least two years.

****On land adapted to that particular crop.

*****All legume seeds should be inoculated with the proper strain of bacteria just prior to planting.

## RECOMMENDATIONS FOR DELTA PASTURE AND GRAIN CROPS

| Pasture Crop | Recommended Varieties | Rate of Seeding per Acre | Fertilizer | Time of Planting |
|---|---|---|---|---|
| Alfalfa | Buffalo, Kansas Common<br>Oklahoma Common | 10-20 lbs. | Test soil for lime, phosphorus and potash. Apply minerals prior to planting and work into seedbed | Oct. 1-15 |
| Bermuda Grass | Common<br>Coastal (Irrigated) | 5 lbs.<br>Sprig | 60 lbs. nitrogen June 1<br>180 lbs. nitrogen (4 applications 45 lbs. each, June 1 and each 30 days) | Mar. 1-May 1<br>Nov. 1-May 1 |
| Dallisgrass | Imported or Domestic | 10 lbs. Live Seed | 30 lbs. Nitrogen June 1 | Mar. 1-May 1 |
| Fescue and Ladino | Kentucky 31 | 5-10 lbs. Fescue<br>1-2 lbs. Ladino | 30 lbs. nitrogen at planting<br>60 lbs. nitrogen September 1 for winter grazing | Oct. 1-Nov. 1<br>Feb.-May 1 |
| Red Clover | Orbit, Port Gibson, Kenland | 10-15 lbs. seed alone or in small grains | Test soil for lime, phosphorus and potash | Oct. 1-Nov. 1 |
| Ladino Clover | | 1-2 lbs. seed with grass | Test soil | Oct. 1-Nov. 1 |
| White Clover | | 2-4 lbs. seed with grass | Test soil | Oct. 1-Nov. 1 |
| Crimson Clover | Hard seeded for volunteer crop | 12-15 lbs. | Test soil for lime, phosphorus, and potash | Oct 1.-Nov. 1 |
| Sudan grass | Tift, Greenleaf | 6-10 lbs. in 40'' rows | 60 lbs. nitrogen prior to planting | June 1-20 |
| Lespedeza | Korean or Climax | 20-25 lbs. seed in small grains | | Feb. 15-Mar. 15 |
| Grain sorghum | DeKalb E56a & D50a, RS 610 | 6 to 8 lbs. in 38'' to 40'' rows | 90 to 120 lbs. nitrogen prior to planting | April 20-July 10 |
| Oats | Delta Red 88<br>Nortex 107<br>Moregrain, Delair, Victorgrain 48-93, Midsouth | 3 bu. for grazing<br>2½ bu. for grain | 60 lbs. nitrogen in Sept. for winter grazing<br>45 to 60 lbs. nitrogen Feb. 20-Mar. 15 for grain | For grazing early September<br>For grain, mid-October |
| Wheat | Chancellor, Atlas 66, Coker 47-27, Anderson, Bledsoe, Knox, Ga. 1123 | 1 ¼ bu. for grain<br>1½ bu. for grazing | Same as for oats | Same as oats |
| Rye | Explorer | 1¼ bu. for grain<br>1½ bu. for grazing | Same as for oats | Same as for oats |

| | | | | |
|---|---|---|---|---|
| Barley | Kenbar, Pace, Dayton Rogers | 75 lbs. for grain<br>90 lbs. for grazing | Same as for oats | Same as for oats<br>Plant only on well drained sandy soil |
| Ryegrass | Annual | 25-30 lbs. | 60 lbs. nitrogen prior to planting<br>60 lbs. nitrogen in March | Sept. 1-30 |
| Johnson grass and red clover mixture | | 10-15 lbs. spring<br>10 lbs. fall | 60 lbs. nitrogen June 15 | April 1-June 1<br>Oct. 1-Nov. 1<br>after Johnson grass established |

## RECOMMENDATIONS FOR LAWNS AND OTHER TURF AREAS

| Grass | Recommended Varieties | Method of Planting | Rate of Planting | Fertilization per 1000 Sq. Ft. per Year |
|---|---|---|---|---|
| Bermudagrass | Common<br>Tiflawn, Ormond. Tifway, Tifgreen, Tex-turf 10 | Seed or sprig<br>sprig | 2 lb./1000 sq. ft.<br>sprig on 6-12 in. rows | 9 lbs. nitrogen,<br>3 lbs. $P_2O_5$<br>4-6 lbs. $K_2O$, split into 4 applications |
| Zoysia | Emerald, Matrella, Meyer | Sprig or plug | Sprigs or plugs 6 in. apart on 6 in. rows | 6 lbs. N<br>2-3 lbs. $P_2O_5$<br>3-4 lbs. $K_2O$ split into 2 applications |
| St. Augustine | Common, Floratine | Sprig | Sprig on 6-12 in. rows | Same as Zoysia |
| Centipede | Common | Seed or sprig | 4 oz./1000 sq. ft.<br>sprig on 6-12 in. rows | 2 lbs. N<br>1-2 lbs. $P_2O_5$<br>1-2 lbs. $K_2O$ split into 2 applications |
| Carpet | Common | Seed | 5 lb./1000 sq. ft. | Same as Centipede |
| Bahia | Argentine, Pensacola, Paraguayan, Wilmington | Seed | 5 lb./1000 sq. ft. | Same as for Zoysia |
| Ryegrass | Italian, Common, Annual | Seed | 8-10 lb./1000 sq. ft. | 1 lb. N/1000 sq. ft. in January if needed |

See next page for additional turf grass information

### Supplementary Information for Lawns and Other Turf Areas

Use the best adapted grass. Bermudagrasses do not survive in the shade, but Zoysia, St. Augustine and Centipede do. In areas where the chinch bug makes the growing of St. Augustine difficult, change to another adapted grass. Tiflawn Bermudagrass, due to its high recovery from use, is excellent on athletic fields and other play areas. Tifgreen Bermudagrass is recommended only for areas that will receive the best of management, such as golf greens and excellently-cared-for-lawns.

New turf areas should have nitrogen, phosphorus and potash worked into the top six inches of the soil prior to planting seed or vegetative material. Established turf areas should be fertilized regularly using a broadcast method of application. For best results begin fertilization of established turf areas in the early spring and continue until late summer. Caution should be exercised when applying fertilizers containing inorganic nitrogen materials to prevent damage to the grass. In any event, fertilized areas should be watered immediately after fertilization to wash fertilizer off the grass leaves and into the soil.

Proper mowing techniques, watering, weed, insect and disease control are also important in a turf management program. To keep turf in a vigorous state of growth, management in all its aspects is important.

## Horticultural Crops

### FERTILIZER RECOMMENDATIONS FOR ORNAMENTALS

Soil tests are recommended. If they are not available, then use the following recommendations.

| Plant | Number of Appli-cations | Time of Appli-cation | Ferti-lizer | Rate* | Remarks |
|---|---|---|---|---|---|
| Shade Trees | | | | | Fertilize at least every 3 years. Distribute in holes 12 in. deep, spaced evenly within branch spread, and use 20 holes/inch of tree diameter. |
| Trunk Diameter under 6 in. | 1 | Oct. to March | 12-8-8 | 1 lb./in. trunk diameter | |
| Trunk Diameter over 6 in. | 1 | Oct. to March | 12-8-8 | 2 lbs./in. trunk diameter | |
| Shrubs and Flowers | 1 | Spring | 6-8-8 | 2-4 lbs./100 sq. ft. | Use 1-2 lbs. per plant for specimen shrubs. |
| Commercial Crops or for special plants | Write for details on specific crops | | | | |

*Equivalent amounts of N-P-K may be applied by other materials.

### FRUIT

#### Apples

Early Harvest, Lodi, Williams Early Red, Cauley, Golden Delicious, Red Delicious, Stayman Winesap.

#### Strawberries

**South Miss.**—Headliner, Klonmore.

**Elsewhere**—Blakemore, Dixieland, Pocahontas, Albritton.

### Pears

Ayres, Orient, Baldwin, Morgan, Garber, Waite, Kieffer.

### Plums

Bruce, Methley, Munson, America, Santa Rosa.

### Peaches

**Central and North Miss.**—Dixired, Dixigem, Redhaven, Triogem, Halehaven, Loring, Sullivans Early Elberta, Georgia Belle, Elberta, Afterglow.

**South Miss.**—Robin, Hiland, Maygold, Keystone, Sunhigh, Hiley, Southland, Redskin, Afterglow.

### Pecans

Stuart, Desirable, Farley, Lewis, Elliot. **Only in South Miss.**—Curtis.

### Blackberries

Thornless Boysen (trailing), Williams (semi-erect), Flint (semi-erect).

### Raspberries

Sodus (purple), Mandarin or Sunrise (red), Manteo (black), Golden, Queen (yellow).

### Muscadines

**Black**—Hunt, *Burgaw, Dulcet, Thomas, *Magoon.

**Bronze**—Scuppernong, *Wallace, Topsail, *Dearing, Higgins.

### Bunch Grapes

Concord or Champanel (blue), Delaware or Salamander (red), Niagara or Portland (white).

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At least one of these pollinator vines must be included with all plantings.

## FERTILIZERS FOR FRUIT CROPS

Recommendations are for annual applications on soils of average fertility where clean cultivation is practiced in the summer. Equivalent amounts of higher analysis fertilizers may be used. Soil samples in commercial orchards may indicate need for different ratios. Commonly in the Delta area, only nitrogen fertilizer is needed.

| Tree Fruits | Grade | Pounds per tree per year of age |
|---|---|---|
| Applied under tree branches before growth begins in spring. | | |
| Apples, Pears | 6-8-8 | 1 |
| If trees blight seriously, nitrogen fertilizer can be reduced or omitted. Maximum rates should be reached at 15-20 years. | | |
| Peaches, Plums | 6-8-8 | 1 |
| | 16% N | ½ |
| Apply two-thirds of N fertilizer before growth begins and one-third in June or July. Maximum rates should be reached at 6 to 10 years. | | |
| Pecans | 6-8-8 | 2-3 |

| Small Fruits | Grade | Lbs. per acre |
|---|---|---|
| Strawberries (Central and North Mississippi) | | |
| February | 6-8-8 | 300-500 |
| June | 6-8-8 | 300-500 |
| September | 6-8-8 | 300-500 |
| In South Mississippi apply 6-8-8 at rate of 6-10 pounds per 100 feet of row before setting plants and 3 to 5 pounds per 100 feet of row in January. | | |
| Blackberries, Dewberries, Raspberries | | |
| February | 6-8-8 | 300-500 |
| June | 6-8-8 | 300-500 |
| | 16% N | 200 |
| | 6-8-8 | 1-6 lbs. per vine |

## VEGETABLE VARIETY AND FERTILIZER RECOMMENDATIONS

The variety and fertilizer information supplied here is made on the basis of tests throughout Mississippi. The varieties listed are suitable for both home garden and commercial purposes unless otherwise designated. Vegetables as a group require more fertilizer per acre than most other crops. The fertilizer recommendations are suggested for all areas of the state except in the Delta area where on most soils nitrogen fertilizer may be all that is required. For problem soils, or for specific recommendations for individual farms, the Mississippi Soil Testing Servce is recommended. This is especially true where the soil reaction (pH) is not known. since many vegetable crop failures are due to improper liming.

| | | | FERTILIZERS Pounds per Acre | | |
|---|---|---|---|---|---|
| CROP | VARIETY | pH | N | $P_2O_5$ | $K_2O$ |
| Asparagus | Mary Washington | 6.0-7.0 | 50 | 100 | 100 |
| | | | After cutting season topdress with | | |
| | | | 25 | 50 | 50 |
| **Beans and Peas** | | 5.8-7.0 | 50 | 100 | 50 |
| Bush Lima | | | Sidedress in full bud stage with | | |
| Small seeded | Clark's Bush | | | | |
| | Henderson, Thaxter, Nemagreen** | | 32 | 0 | 0 |
| Large seeded | Fordhook 242 | | | | |
| Colored seeded | Jackson Wonder | | | | |
| Pole type lima | Carolina Sieva,<br>Willow Leaf, Florida Speckle | | | | |
| Bush snap | Longval, Contender (oval)<br>Harvester, Extender,<br>Wade (round) | | | | |
| Pole snap | Kentucky Wonder<br>Blue Lake | | | | |
| English Pea | Thomas Laxton, Wando,<br>Little Marvel | | | | |
| Southern Pea | Mississippi Crowder,<br>Bunch Purple Hull,<br>Dixilee, Monarch | 5.8-7.0 | 30 | 40 | 40 |
| Broccoli | Coastal, De Cicco,<br>Green Mountain | 5.5-6.5 | 75 | 100 | 100 |
| | | | 20-40 lbs. borax | | |
| | | | When heads begin to form sidedress with | | |
| | | | 32 | 0 | 0 |
| Cabbage | Round Dutch, Early<br>Jersey Wakefield* | | | | |
| Cauliflower | Snowball-E and/or -M | | | | |
| Collard | Vates, Morris Heading | | | | |
| Mustard | Florida Broadleaf,<br>Giant Southern Curled | | 48 | 48 | 48 |
| | | | Sidedress with | | |
| Radish | Cherry Belle, Scarlet<br>Globe, White Icicle (long) | | 32 | 0 | 0 |
| Turnip | Purple Top White Globe<br>Shogoin (greens) | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Beet | Detroit Dark Red | 6.0-7.0 | 75 | 100 | 100 |
| | Crosby Egyptian | | Sidedress with | | |
| Carrot | Gold Spike, Touchon, | | 32 | 0 | 0 |
| | Imperator | | | | |
| Spinach | | | | | |
| Savoy | Bloomsdale Long Standing, | | | | |
| | Old Dominion | | | | |
| Smooth | Viroflay, | | | | |
| | Hybrid No. 7 or 10 | | | | |
| Cantaloupe | Rio Gold, Edisto, | 5.5-6.5 | 40 | 80 | 80 |
| | Hales Best No. 36, | | When plants begin | | |
| | Homegarden* | | to run sidedress | | |
| Cucumber | | | with | | |
| Slicing | Ashley, Palmetto | | 30 | 30 | 30 |
| Pickling | Model | | | | |
| Squash | Early Summer Crookneck, | | | | |
| | Early Prolific Straightneck, | | | | |
| | White Bush Scallop | | | | |
| Watermelon | Blackstone, Shipper, | | | | |
| | Charlston Gray | | | | |
| Eggplant | Florida Market, | 5.5-6.0 | 75 | 100 | 100 |
| | Black Beauty | | Sidedress with | | |
| Irish Potato | LaSoda, Katahdin, | | 32 | 0 | 0 |
| | Kennebec | | | | |
| Pepper, Bell | Early Calwonder, | | | | |
| | Keystone Resistant Giant | | | | |
| Pepper, Hot | Long Red Cayenne | 5.5-6.0 | 40 | 80 | 80 |
| Pepper, Pimiento | Truhart Perfection | | Sidedress with | | |
| | | | 30 | 30 | 30 |
| Tomato | | 6.0-7.0 | 60 | 120 | 60 |
| Red | Marion, Kokomo | | Sidedress with | | |
| Pink | Pink Shipper, Bradley | | 40 | 40 | 40 |
| Greenhouse Production | Tuckcross O or V | | | | |
| Lettuce, | | 6.0-7.0 | 75 | 100 | 100 |
| Leaf | Grand Rapids, Bibb, | | Sidedress with | | |
| | Salad Bowl | | 32 | 0 | 0 |
| Head | Great Lakes (A-36 or 118) | | | | |
| Okra | Emerald, Clemson | 6.0-6.5 | 60 | 80 | 80 |
| | Spineless, Louisiana | | Sidedress with | | |
| | Green Velvet | | 20 | 0 | 0 |
| Onion | Grano, Granex, | 6.0-7.0 | 50 | 100 | 100 |
| | Multiplier | | Sidedress with | | |
| | | | 50 | 0 | 0 |
| Sweet Corn | Royal Gold, Golden | 5.5-6.5 | 30 | 40 | 40 |
| | Security, Aristogold | | Sidedress with | | |
| | Bantam, Evergreen | | 64 | 0 | 0 |
| Sweetpotato | Centennial, Goldrush, | | 40 | 80 | 80 |
| | Unit I Porto Rico | | | | |

*Home Garden only. **For areas where nematodes are a problem.

## TUNG

**Varieties:** Isabel (L-2), Folsom (L-47), Gahl (L-51), La Crosses (F-99), and Lampton (F-587).

**Fertilization:** Apply fertilizer to non-bearing tung trees as shown in Table 1. Fertilize newly planted trees after growth starts, spreading the mixture evenly in bands about 6 inches wide, the inner edges of the bands about 12 inches from the tree trunks. In the second year after planting and subsequently, spread the fertilizer evenly under the spread of the branches shortly before or when growth starts.

Fertilize bearing trees as soon as possible after they blossom, adjusting rates to the estimated yield as shown in Table 2. Specific modifications of these recommendations appropriate for individual orchards can be made on the basis of leaf analyses by Experiment Station or U.S.D.A. Tung Laboratory personnel, who will furnish instructions for sampling leaves.

If a major portion of the crop is lost by frost, applying a low level of nitrogen will tend to minimize biennial bearing. However, uptake of potassium from the soil is slow, even in a year of light or no crop, at least 50 pounds of $K_2O$ per acre is required to maintain the trees in healthy condition and insure good oil content in the fruit of the following year when a heavy crop is to be expected.

Usually it is more economical to apply the nitrogen as anhydrous ammonia, aqua ammonia, or ammonium nitrate, and the phosphorus and potassium as 0-10-3 or superphosphate and muriate of potash than to apply a complete mixed fertilizer. If inadequate zinc is indicated by leaf analysis or symptons apply 2 oz. of commercial zinc sulphate per tree under 5 years of age. For those over 5 years old apply 4 ounces. If magnesium or calcium is deficient, dolomitic lime should be applied to bring the soil pH up to 5.5 or 6. Apply all solid fertilizers in bands 4 to 5 feet wide on each side of the tree row and cultivate to incorporate it in the soil.

**Table 1.—Fertilizer requirements of non-bearing tung trees.**

| Year in the orchard | Fertilizer formula | Amount (lbs./tree) |
|---|---|---|
| First (newly planted) | 5-10-5 | 1 |
| Second | 5-10-5 | 1½ |
| Third | 10- 5-10 | 2½ |

**Table 2.—Approximate requirements of nitrogen, phosphrous, and potassium in relation to yield of bearing tung trees.**

| Estimated yield | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|
| Tons per acre | | Lbs. per acre | |
| 0 to 1 | 0 to 50 | 25 | 50 to 75 |
| 1 to 2 | 50 to 80 | 40 | 75 to 125 |
| 2 or more | 80 to 120 | 60 | 125 to 175 |